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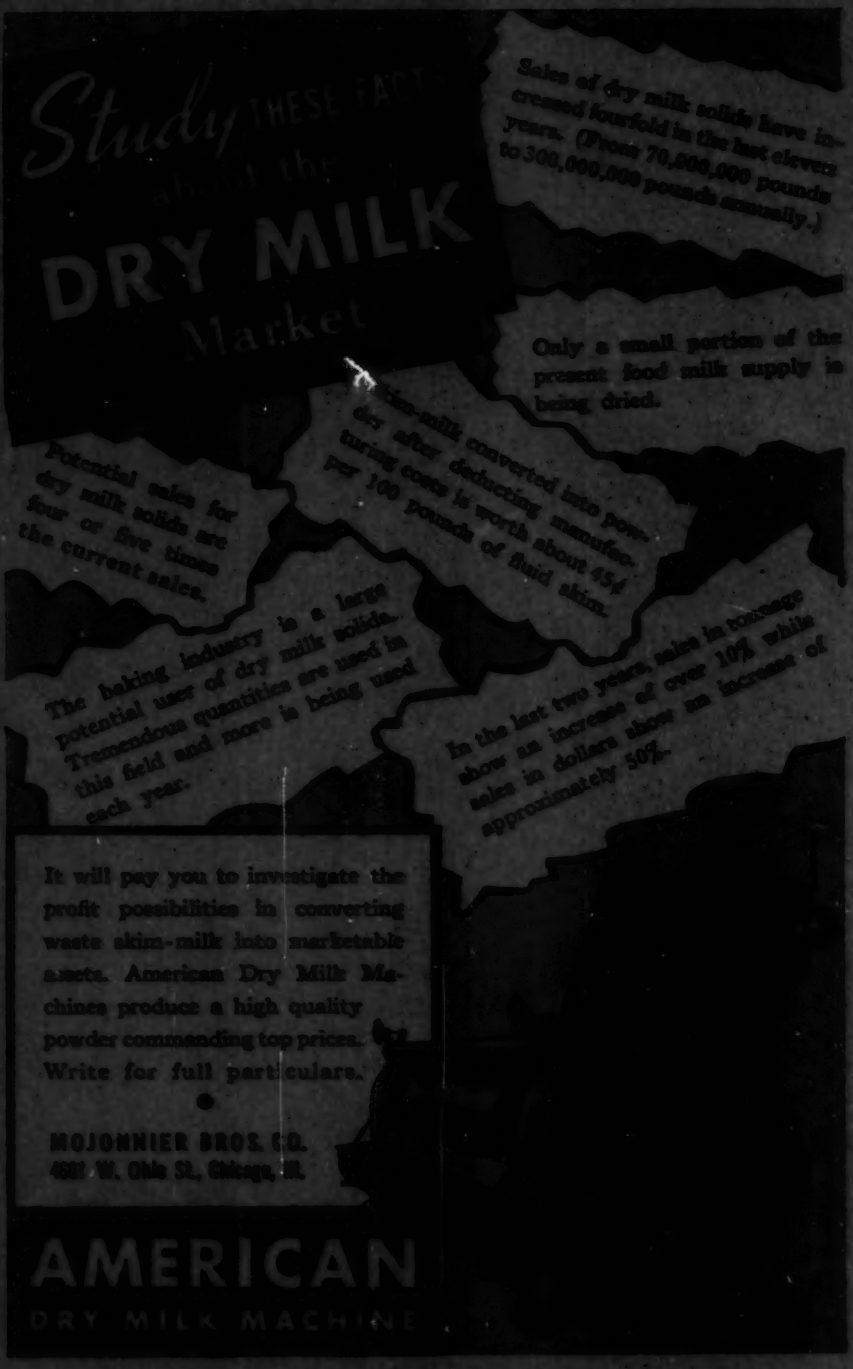
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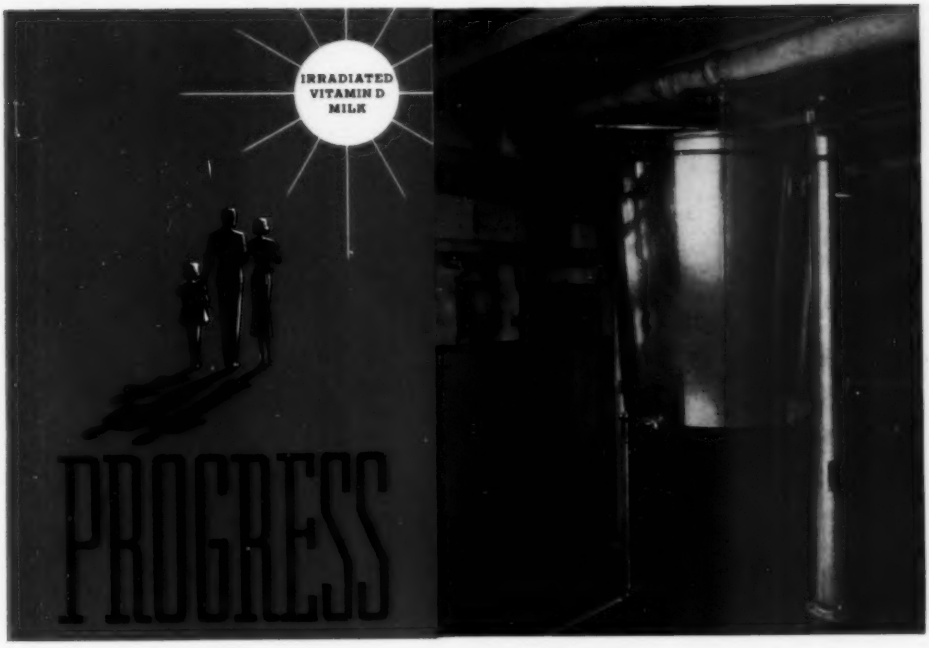

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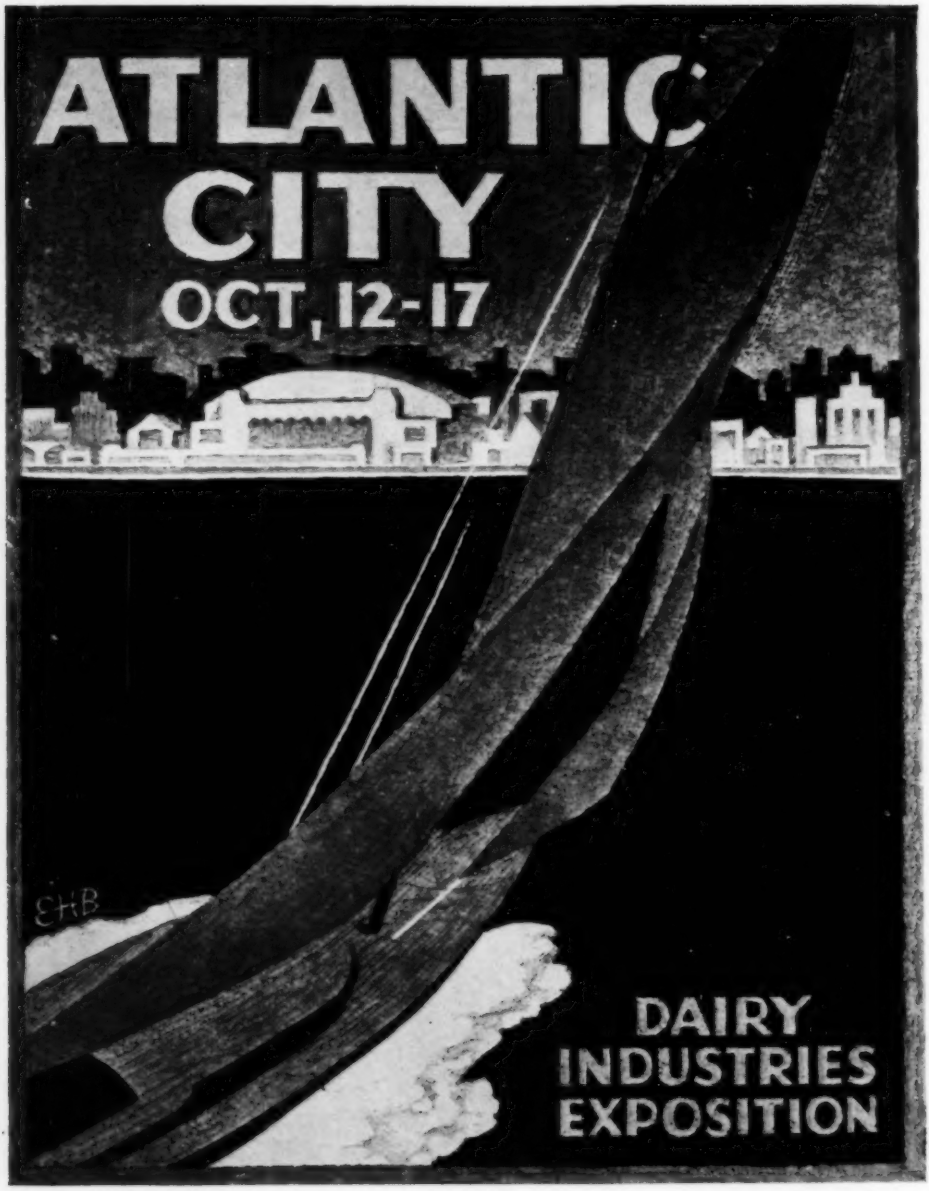

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JOURNAL OF DAIRY SCIENCE

VOLUME XIX AUGUST, 1936 NUMBER 8

THE COMPOSITION AND APPARENT DIGESTIBILITY OF THE FLAT PEA (LATHYRUS SILVESTRUS WAGNERI)[1]

R. E. HODGSON AND J. C. KNOTT

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INTRODUCTION

The production of an abundance of palatable, nutritious forage is essential to economical milk production. High yielding pastures usually produce the cheapest feed nutrients. In general, hilly, upland pastures are rather unproductive and unfortunately constitute the major portion of the pasture area of Western Washington. Much can be done to increase the yield of such pastures by intensive pasture management and by introducing new plant species to replace the native low yielding forages. Untried crops that produce a large growth, that are permanent in nature, deep rooted and drought resistant deserve consideration for this purpose.

One such crop which has many desirable characteristics is the Flat Pea (*Lathyrus silvestrus Wagneri*). This crop is being considered for use as pasture in the upland districts of Western Washington.

The literature contains little information on the value of the Flat Pea as a crop. The available information is effectively summarized by Piper (1). He reports high yields, difficulty in securing a stand, conflicting opinions on palatability, and indicates its place among our forage crops as follows:

"The Flat Pea has nowhere in America attained any definite status as a field crop, but where a long-lived perennial legume is needed in the Northern States probably no other species is better adapted to the purpose."

This paper is a report of the composition and apparent digestibility of Flat Pea forage.

EXPERIMENTAL

The Flat Pea forage used in this experiment was secured from a field near Ashford, Washington. This field, located on a mountain side, was

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[1] Published as Scientific Paper No. 336, College of Agriculture and Experiment Station, State College of Washington.

[2] The writers are indebted to Mr. Vernon Miller who conducted the analytical work involved in this investigation.

seeded over 30 years ago. The stand has resisted infestation with weeds and brush to a marked degree and appears to be spreading slowly. Cattle have grazed on this field to some extent. The forage was cut on August 24, 1935, and cured in the sun. When cut the peas were in full bloom, some of the lower pods had seeds in them and the forage was from three to four feet high. The freshly cut forage had an average dry matter content of 22 per cent.

The apparent digestibility of the sun-cured Flat Pea was determined by feeding it as an exclusive ration to three wether lambs. The methods used in conducting the digestion trials were the same as that described by Hodgson and associates (2), following the procedure outlined by Forbes and Grindley (3).

A sufficient amount of the hay to last the entire trial was weighed out in individual feedings and stored in paper bags. The forage was carefully sampled for chemical analysis at the time the experimental rations were prepared.

The sheep were fed twice daily and all of the feed offered was consumed. At the end of the experimental day the feces were collected, thoroughly mixed, weighed, and 50 per cent of the daily excretion was saved for chemical analysis. The samples were collected and stored in a refrigerator at 14° F. At the close of the collection period the daily aliquots of feces of each sheep were mixed and sampled for chemical analysis. The analyses of the feeds and feces were made by the usual methods as outlined by the Association of Official Agricultural Chemists (4).

EXPERIMENTAL RESULTS

The results of the experiment are presented in two tables. Table 1 shows the percentage composition of the Flat Pea hay and of the feces excreted by each of the three sheep. In Table 2 are shown the amounts of dry matter and nutrients ingested, voided, digested, and the percentage digestibility. The results obtained on each of the three sheep are in close agreement. The average daily consumption of dry matter by the sheep amounted to 770 grams and at that intake they lost an average of one pound of live weight during the 21 day test period. After the sheep became accustomed to the feed they consumed it readily.

TABLE 1

Percentage composition of feed and feces (dry matter basis)

MATERIAL	DRY MATTER	CRUDE PROTEIN	CRUDE FIBER	ETHER EXTRACT	NITROGEN-FREE EXTRACT	ASH
Flat Pea hay	82.9	25.29	29.83	2.23	36.62	6.03
Feces-Sheep 1	42.5	14.35	43.06	3.09	31.83	7.67
Feces-Sheep 2	35.9	13.76	44.03	2.99	31.90	7.32
Feces-Sheep 3	40.5	13.36	44.00	3.01	32 53	7.10

TABLE 2

Dry matter and nutrients ingested, voided, and digested by sheep receiving a ration of flat pea hay

	DRY MATTER	CRUDE PROTEIN	CRUDE FIBER	ETHER EXTRACT	NITROGEN-FREE EXTRACT	ASH
Sheep I						
Fed, grams	9865.1	2494.9	2942.8	220.0	3612.6	594.9
Voided, grams	3795.3	544.6	1634.3	117.3	1208.0	291.1
Digested, grams	6069.8	1950.3	1308.3	102.7	2404.6	303.8
Digested, per cent	61.53	78.17	44.46	46.68	66.56	51.07
Sheep II						
Fed, grams	7875.5	1991.7	2349.3	175.6	2884.0	474.9
Voided, grams	3130.1	430.7	1378.2	93.6	998.5	229.1
Digested, grams	4745.4	1561.0	971.1	82.0	1885.5	245.8
Digested, per cent	60.25	78.37	41.34	46.70	65.38	51.76
Sheep III						
Fed, grams	11606.0	2935.2	3462.1	258.8	4250.1	699.8
Voided, grams	4740.9	633.4	2086.0	142.7	1542.2	336.6
Digested, grams	6865.1	2301.8	1376.1	116.1	2707.9	363.2
Digested, per cent	59.15	78.42	39.75	44.86	63.71	51.90
Average						
Fed, grams	9782.2	2473.9	2918.1	218.1	3582.2	589.9
Voided, grams	3888.8	536.2	1699.5	117.9	1216.2	285.6
Digested, grams	5185.4	1381.6	1218.5	100.3	2332.7	295.4
Digested, per cent	60.31	78.32	41.85	45.75	65.22	51.58

The average composition of the dry matter of the Flat Pea hay approximates that reported by Henry and Morrison (5). The material had a high protein content for forage harvested in the late bloom stage which was probably due to the leafy, weak stemmed nature of the plant. The fiber content is not unusually high for that type of forage.

An analysis of the data in Table 2 shows that the apparent digestibility of the various nutrients compares favorably with that of alfalfa and the commonly used clover hays. The protein digestibility was higher while the crude fiber and nitrogen-free extract was slightly lower.

SUMMARY

Digestion experiments with three wether lambs were conducted to determine the apparent digestibility of Flat Pea (*Lathyrus silvestrus Wagneri*) hay.

The crude protein which constituted 25.3 per cent of the dry matter of the Flat Pea hay had an average digestibility coefficient of 78.3 per cent. The apparent digestibility of the crude fiber was 41.8 per cent; ether extract, 45.8 per cent; nitrogen-free extract, 65.2 per cent; and ash, 51.6 per cent.

On the basis of the composition and apparent digestibility as determined in this experiment, 100 pounds of dry matter would contain 19.7 pounds of digestible crude protein and 58.4 pounds of total digestible nutrients.

The results indicate that the Flat Pea forage is palatable and highly nutritious.

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THE BACTERIOLOGY OF SWISS CHEESE

V. The Use of *Streptococcus thermophilus* in Ripening Milk for Swiss Cheese

W. C. FRAZIER,* H. F. LONG,** and Wm. T. JOHNSON, Jr.
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The so-called "ripeness" of milk to be used in making Swiss cheese has been the subject of much study but cause and definition of ripeness are still unknown. The cheesemaker judges the ripeness of the milk by the way it acts in the kettle and in particular by what he calls the "grip" of the curd. The most commonly used method to estimate the state of ripeness of milk has been the methylene blue reduction test: a short reduction time has been taken to indicate a ripe milk. *Streptococcus lactis* or similar organisms have been considered the most active in ripening milk and when milk is held to develop ripeness, conditions are usually such as to favor this type of organism.

As early as 1906, however, Orla-Jensen (3) thought that the ripening was probably not due to the ordinary *Str. lactis* but to a lactic streptococcus which could grow at temperatures as high as 48° C. and which did not grow at temperatures below 20° C. He said that keeping the night's milk warm favored this organism and helped ripening. This organism was undoubtedly of the *Str. thermophilus* type. It has often been observed that if a cheesemaker sends back whey in the cans in which his patrons brought the milk that the milk on following days is riper than when the whey is sent back in different cans. This whey ordinarily contains only lactobacilli which would grow to a limited extent in milk at the temperatures at which it is usually held and *Str. thermophilus* which will grow at temperatures as low as 20° C.

It is rather difficult to control ripening of milk when the milk is held over either with or without inoculation with lactic streptococci. There is always the possibility of the growth of gas organisms or too much growth of lactic bacteria. It was thought that if *Str. thermophilus* could be used for ripening that this organism might be grown in milk at such a high temperature that most other bacteria could not grow, and that ripening might be accomplished in a short time under controlled conditions. Experiments were conducted at Washington, D. C., with small cheeses of 50–55 pounds, green weight, and at the Grove City Creamery, Grove City, Pa., with large cheeses of 155–160 pounds, green weight. Methods of sampling and examination were as described in paper No. II (1) of this series.

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* Resigned September 15, 1934.

** Resigned February 29, 1932.

EXPERIMENTAL

In the experiments at Washington attempts were made at first to ripen the milk over night with *Str. thermophilus* (C_3 strain) at from 20° to 25° C. In a few experiments some of the milk was pasteurized, cooled and inoculated with C_3. In all experiments in which part of the milk was inoculated with C_3 and held over night the resulting cheeses were No. 2 grade while the control cheeses were better. Similar results were obtained with over night ripening after inoculation with *Str. lactis*. The addition of *Str. lactis* to the first portion of milk into the cheese kettle also gave unsatisfactory results.

In other experiments part of the milk, usually about one-fifth of the total amount to be used in the kettle, was heated to 48 to 50° C., inoculated with one-fourth per cent of a milk culture of C_3, held to temperature for a period varying from 30 minutes to an hour and 135 minutes in different experiments, and then cooled by mixing the heated milk with the remainder of the milk in the cheese kettle.

The results of parallel experiments on ripening milk with C_3 for the manufacture of small cheeses at Washington are shown in table 1. It will

TABLE 1

Comparison of small cheeses made with and without ripening with Str. thermophilus (C_3)

CHEESE NO.	C_3 RIPENING		GRADE	SCORE	REMARKS
	Time	Temp.			
1405–1	.....	.....	Poor No. 1	78.75	.....
1405	80	48	Fair No. 1	82.50	Less checking, better eyes
1447–1	.....	.....	No. 2	68.0	.....
1447	60	50	Special	77.0	Less checking and glass
1422–1	.....	.....	Poor No. 1	78.5	.....
1422	69	50	Fair No. 1	80.0	Less checking
1449–1	.....	.....	Fair No. 1	82.0	Better eyes, less glass
1449	75	50	No. 2	69.0	.....
1428–1	.....	.....	Poor No. 1	77.5	.....
1428	80	50	Poor No. 1	79.0	Less checking
1409–1	.....	.....	Special	73.5	Eyes slightly better
1409	96	50	Special	71	.....
1424–1	.....	.....	Fair No. 1	81.5	Better eyes, less checking
1424	135	50–52	Special	73.5	.....

be noted that ripening part of the milk for a short period improved the quality of the cheese, while ripening for 75 minutes or over either did not improve or else harmed the quality of the cheese. Part of the milk for cheese No. 1405 was ripened at 48° C., instead of 50°, and for 80 minutes with a resulting improvement in the quality of the cheese.

The growth of *Str. thermophilus* (C_3) in the kettle and the first hours in the press in a pair of cheeses is shown in table 2. Part of the milk in the

TABLE 2

Growth of Str. thermophilus (C_3) in cheese with and without "C_3 ripening"

SAMPLE	CONTROL CHEESE NOS. OF C_3 PER CC. OR GM.	CHEESE WITH C_3 RIPENING NOS. OF C_3 PER CC. OR GM.
Kettle milk	3,130,000	6,720,000
Before cooking	5,740,000	37,900,000
Before dipping	8,890,000	44,700,000
1 hr. after dipping	48,500,000	81,500,000
3 hrs. " "	42,800,000	109,000,000
5 " " "	91,200,000	98,900,000
8 " " "	202,000,000	93,000,000

test cheese had been ripened with C_3, at 50° C. and none of the milk in the control cheese had been ripened. The C_3 coccus is shown to be especially active in the kettle and to grow to a limited extent in the cheese in the press when part of the milk had been ripened with C_3. In the control cheese there was a gradual increase in numbers of C_3 organisms in the kettle contents and after the cheese had been on the press for three hours. In both cheeses the increase in numbers after dipping is due to concentration of the bacteria in the curd and not to growth. Similar results obtained with other pairs of cheese indicated that most of the *Str. thermophilus* organisms added by ripening part of the milk grew only in the kettle and showed little or no increase in numbers after the first few hours in the press. For this reason a *Str. thermophilus* starter was added, even when part of the milk had been ripened with C_3, so that growth would take place in the cheese in the press.

Ripening part of the milk with *Str. thermophilus* was tried with a number of large wheels of Swiss cheese made at Grove City. The results obtained appeared inconsistent until the ripeness of the milk as indicated by the methylene blue reduction time was considered. Table 3 shows how the

TABLE 3

Influence of ripeness of milk on success of C_3 ripening of milk for large cheeses (Grove City, Pa.)

REDUCTION TIME	NO. OF CHEESES	NO. 1 OR FANCY		SPECIAL		TOTAL CUTTABLE	NO. 2	
Hours		*No.*	*Per cent*	*No.*	*Per cent*	*Per cent*	*No.*	*Per cent*
Less than 5	16	7	43.75	6	37.50	81.25	3	18.75
5 or more	39	28	71.80	10	25.64	97.44	1	2.56
6 or more	25	18	72.00	7	28.00	100.00	0	0.0

success of ripening with C_3 was apparently dependent on the ripeness of the kettle milk. When the methylene blue reduction time was five hours or

over there was an apparent benefit from ripening with *Str. thermophilus*. For comparison results are given in table 4 of cheeses made during the same

TABLE 4

The relationship of the methylene blue reduction time of the milk to the quality of large cheeses made at Grove City, Pa.

REDUCTION TIME	NO. OF CHEESES	NO. 1 OR FANCY		SPECIAL		TOTAL CUTTABLE	NO. 2	
Hours		*No.*	*Per cent*	*No.*	*Per cent*	*Per cent*	*No.*	*Per cent*
Less than 5	10	7	70.00	2	20.00	90.00	1	10.00
5 or more	22	13	59.09	7	31.82	90.91	2	9.09

period without ripening. It will be observed that better cheeses resulted when the reduction time was less than 5 hours (it was never less than 3 hours) than when it was over 5 hours, and that the percentage of high grade cheeses made from unripened milk with a methylene blue reduction time of over five hours was lower than the percentage made from ripened milk, which, without ripening, had a reduction time of over five hours. A series of parallel experiments was conducted, in which the test cheeses were ripened with C_3, but no usable results were obtained because during this period the methylene blue reduction time was consistently 5 hours or less.

An examination of the changes in pH of the interior of cheeses made with milk part of which had been ripened with C_3 shows, as would be expected, a more rapid drop in pH during the first few hours in the press than in control cheeses and a higher pH after 21 hours. The average pH of large cheeses made from milk ripened with the C_3 streptococcus was 6.35 at dipping (0 hours), 5.89 three hours after dipping, 5.69 eight hours after dipping, and 5.32 twenty-one hours after dipping. The corresponding pH values of control cheeses were 6.37, 6.13, 5.99 and 5.17, respectively. Thus the pH values of cheeses made with milk part of which had been ripened with *Str. thermophilus* are different from the pH values found best for cheese made from unripened milk as cited in a previous paper of this series (2).

DISCUSSION

As has been shown, ripening of part of the milk with *Str. thermophilus* is not advantageous unless the milk has a fairly long methylene blue reduction time. If the milk has a reduction time of five hours or less ripening with *Str. thermophilus* is not to be recommended. In practice the kettle milk at most Swiss cheese factories has a methylene blue reduction time or less than five hours during most of the year. During the winter, however, the reduction time may be longer. If the milk is being produced under carefully controlled conditions and is being cooled promptly to a low temperature it may have a long reduction time during most of the year. Then ripening with *Str. thermophilus* may be helpful.

SUMMARY

Attempts were made to ripen milk for Swiss cheese by inoculation with *Str. lactis* or *Str. thermophilus* and holding over night at 20 to 25° C. Inoculation of the kettle milk with *Str. lactis* was also attempted. About one-fifth of the milk to be used in making Swiss cheese was heated to 50° C., inoculated with *Str. thermophilus* and held for varying periods at that temperature before it was mixed with the rest of the milk for the cheese. Cheeses made with this milk were compared with cheeses made from untreated milk. The experiments led to the following conclusions:

1. Ripening milk by inoculating it with *Str. lactis* or *Str. thermophilus* and holding it over night at 20 to 25° C. did not produce satisfactory results, nor did the addition of *Str. lactis* to the kettle milk.

2. A temperature of 50° C. with a holding time of from 30 to 60 minutes has been satisfactory for ripening the milk with *Str. thermophilus.*

3. *Str. thermophilus* introduced into the kettle milk by addition of milk ripened with this organism increased in numbers to a greater extent in the kettle than did *Str. thermophilus* added as a starter, but grew slightly or not at all in the press.

4. Ripening with *Str. thermophilus* usually improved the quality of the cheese when the methylene blue reduction time of the kettle milk was 5 to 6 hours or longer, but was not helpful if the milk had a shorter reduction time.

5. pH values of the interior of the cheeses made with milk ripened with *Str. thermophilus* were lower in the early hours that the cheeses were in the press and higher after 21 hours in the press than the pH values of cheeses made with unripened milk.

6. Ripening part of the cheese milk with *Str. thermophilus* may be used to improve the quality of Swiss cheese when the kettle milk acts "dead," that is, the curd does not have the proper "grip" or consistency in the kettle.

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THE INFLUENCE OF METHOD OF STERILIZING EQUIPMENT UPON DEVELOPMENT OF OXIDIZED FLAVOR IN MILK*

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It is very probable that an effect of certain metals upon the flavor of milk was observed from the very beginning of the extensive use of metals for equipment at the close of the last century. Both tin and oak were recommended for dairy equipment from 1850 to 1875. Commencing about 1920 the effect of metals on flavor of milk has been subjected to numerous studies probably due to the development of new alloys and to marked improvement in the quality of milk products. Hunziker, Cordes, and Nissen (1) in their extensive investigations of metals in dairy equipment reported that copper and iron produced metallic flavors in sweet milk. Kende (2) was probably the first to establish that this flavor (metallic, cappy, cardboard, stale, or oxidized) might develop in milk not subjected to exposure to either iron or copper. The development of the oxidized flavor was accelerated by increased copper content of the milk, by pasteurization at 63° C. for 30 minutes, by very low bacterial counts, and by elimination of green feeds in the rations of the cows. Davis (3) found that the contamination of milk with copper was greatest in the first milk through the equipment and that such milk became oxidized in flavor. Tracy, Ramsey, and Ruehe (4) gave special attention to the oxidative nature of the change which produced the off-flavor and to the deleterious effect produced on the first milk through the equipment.

In 1932 it was noticed in our dairy operations that chlorine sterilization of equipment greatly accelerated the development of oxidized flavor when compared with hot water sterilization. It was believed that this effect was due to high copper contamination and experiments were planned to establish this relationship.

EXPERIMENTAL METHODS

Milk Production Methods—In these studies it was planned to have all conditions favorable to the development of the oxidized flavor except metal contamination. The experiments were conducted in January, February, and March when the cows were on winter feeds. Bacterial counts were held low by careful cleaning and sterilization of equipment used in the barn. Pails, cans, etc., were sterilized in a cabinet heated to 200° F. for 10 minutes

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and this cabinet also served as a drier. The milking machine rubber parts were sterilized with hot water at 165–170° F. for 2 minutes immediately after and just before use. No chlorine was employed for sterilizing any of the barn utensils.

Contact of the milk with all metals except aluminium was avoided until the milk reached the pasteurizing room. The milk passed through rubber tubes into aluminum pails. It was poured directly into aluminum cans which were placed in ice water for cooling the milk. The only contact with any other metals was a well tinned stop-cock in the milk line at the head of the milking machine pail.

In the pasteurizing room the milk was stirred in the aluminum cans and sampled for bacteriological analyses, for copper and iron determinations, and for flavor and keeping quality. It was then emptied into a 20-gallon well-tinned copper tank, pumped through a bronze rotary pump, through a filter into a 125-gallon spray vat pasteurizer lined with 18–8 alloy steel. The sanitary piping was nine feet in length and was an alloy of iron, nickel, and copper. After pasteurization at 143° F. for 30 minutes the milk passed through four feet of piping to a surface tubular cooler on which it was cooled below 40° F. before entering aluminum cans. The first 25 pounds of milk off the cooler were caught in a sterilized can, the next 25 pounds in another sterile can, then the next 50 pounds, then the next 100 pounds, then the next 100 pounds, and finally another 100 pounds. Samples were secured of each consecutive batch of pasteurized milk for analysis and flavor tests.

Sterilization Procedures—The principal objective of the investigation was to establish the relationship of the method of sterilization to the development of oxidized flavor. When hot water sterilization was employed, water at 165–170° F. was pumped through the pipe line into the pasteurizer and over the cooler for a period of 5 minutes just prior to use. Two methods were followed with chlorine sterilization. In the one instance 15 gallons of a chlorine solution with a sodium carbonate base, containing 100 parts per million of available chlorine were pumped through the equipment at 100° F. Immediately thereafter the milk was pumped into the pasteurizer. A period of nearly one hour elapsed before the hot milk began to flow over the cooler. In another series of tests the contact of the chlorine solution with the metal lasted for 5 minutes after which period water at 165–170° F. was pumped through the equipment with the thought that the action of chlorine on the metal would be stopped by the rinse. In all instances sterilization was accomplished just prior to use of the equipment.

Keeping Quality Tests—The cooled milk was promptly placed in sterilized pint glass bottles and stored at 34–40° F. At the end of one hour, and one, two, and three days a bottle of each sample was warmed to 80° F., scored independently by three judges, and discarded.

Bacteriological Methods—The bacterial content of the raw and pasteurized milks was estimated by the plate method and the methylene blue reduc-

tion test following Standard Methods. It was recognized that more accurate procedures might have been employed to estimate bacterial numbers but the methods employed were ample to establish the point under consideration, namely that the milk was of low bacterial content. Bacterial counts and methylene blue tests were made in duplicate on each sample of milk each time that it was scored for flavor.

The bacteriological data obtained are not presented in detail as they are negative and it is important in this study only to know that the count was very low. All samples of raw milk when fresh and after storage at 34–40° F. for one, two, and three days gave a standard plate count which varied from 1,200 to 8,000 with the majority of counts ranging from 2000 to 5000. The methylene blue reduction time of the fresh and aged raw milks varied from 11 to 25 hours with the majority of periods ranging from 18 to 22 hours. The bacterial counts of the fresh and aged pasteurized milks were nearly all below 100 and no count exceeded 250. The methylene blue reduction periods for the pasteurized milks varied from 15 to 30 hours with a majority of tests from 20 to 25 hours. These data clearly exclude bacteria as a cause or a preventative of the oxidized flavor.

ANALYSIS OF MILK FOR COPPER AND IRON

The difficulties in the determination of micro-quantities of copper and iron as usually present in milk have been recently reviewed by Conn, Johnson, Trebler and Karpenko (5). The analytical procedure which we have used was based largely on the method adopted by these workers with certain minor modifications, the chief one of which was the extraction of the colored copper diethyldithiocarbamate complex with iso-amyl alcohol previous to the comparison with a standard in the colorimeter. This procedure obviated the troublesome turbidity often encountered with aqueous solvents. Another modification was the precipitation of CuS from a normal HCl solution instead of a 1 per cent solution as used by the foregoing workers.

General Precautions—By no means the least important part of securing high accuracy in these determinations has been scrupulous cleanliness with regard to glass, platinum ware, etc. and protection from dust. Distilled water, hydrochloric acid and ammonia were redistilled in all glass equipment to render them copper and iron free. Other chemicals did not require purification beyond the usual analytical grade because of the fact that only small amounts were required in the analyses and a blank determination took care of this correction.

Preparation of Sample—Samples were withdrawn from well agitated milk and stored in stoppered glass Erlenmeyer flasks at 32–38° F. until such time as the analyses could be made. Samples were preserved with two drops of formalin solution added to 250–300 cc. of milk. The cream layer

was thoroughly dispersed in the milk by shaking after warming to 110–120° F. and 100 gm. samples removed for analysis and transferred to platinum evaporating dishes. All analyses were made in duplicate.

Evaporation and Ashing—To precipitate a large share of the protein and reduce foaming, 5 drops of glacial acetic acid were added to the sample which was evaporated to dryness on the electric hot plate. Sample was then ashed at a temperature not to exceed 560° C. in an electric muffle to give a whitish gray ash.

Solution of Ash and Reashing of Residue—To the cooled ash 4–5 cc. of 20 per cent HCl were added, the dish warmed on the hot plate to dissolve the ash and the solution transferred to a 15 cc. centrifuge tube with as little wash water as possible. The tube was centrifuged for 10 minutes at 1800 r.p.m. to throw down the small amount of unburned carbon and the solution transferred to a second centrifuge tube. The unburned carbon was rinsed into the platinum dish, evaporated to dryness and again ashed in the muffle. The residue was dissolved in 0.5 cc. of 20 per cent HCl and washed into the centrifuge tube containing the bulk of the sample. Twenty per cent NH_4OH solution was added drop by drop to the acid solution until a faint precipitate of $CaHPO_4$ was formed which remained after stirring with a fine glass rod. Sufficient HCl was then added to bring the acid concentration to normal strength.

Precipitation of CuS—The sample in the centrifuge tube was heated in a boiling water bath and saturated with H_2S gas through a fine capillary tube while cooling, the delivery tube being washed off with a few drops of normal HCl saturated with H_2S. The tube was stoppered and allowed to stand over night.

Centrifuging and Dissolving of CuS—After standing over night, the samples were centrifuged 30 minutes at 1800 r.p.m. The supernatant liquid was poured off and saved for the iron determination and the precipitated CuS was washed with 2 cc. of normal HCl saturated with H_2S and centrifuged 30 minutes and the wash solution added to that previously reserved for the iron determination. To the CuS which remained in the centrifuge tube 4–6 drops of fuming HNO_3 were added and the tube warmed in a boiling water bath for 10 minutes for solution to take place. The sample was then cooled, 5 cc. of water added and then made alkaline with 1 cc. of 20 per cent NH_4OH and washed into a separatory funnel with about 5 cc. of water.

Colorimetric Estimation of Copper—To the sample in the separatory funnel 1 cc. of a 0.1 per cent aqueous solution of sodium diethyldithiocarbamate was added and then exactly 10 cc. of iso-amyl alcohol and the funnel well shaken. The golden colored copper diethyldithiocarbamate complex was completely extracted from the aqueous layer by the amyl

alcohol and the latter was drawn off and compared in a colorimeter with a copper standard of about the same color intensity prepared in the same way from a standard $CuSO_4$ solution.

Colorimetric Estimation of Iron—The mother liquid from which the copper was precipitated by H_2S and the wash solution from washing the CuS was made up to 50 cc. in a volumetric flask. A 10 cc. aliquot of this was pipetted into a 150 cc. beaker, 5 cc. of 20% HCl added and the volume made up to 25 cc. after which the solution was boiled for 20 minutes, cooled, 1 drop of HNO_3 added and transferred to the separatory funnel where 1 cc. conc. HCl and sufficient n/10 $KMnO_4$ solution (1–2 drops) to give a pink color was added. Exactly 10 cc. of iso-amyl alcohol and 5 cc. of a 20 per cent KCNS solution were added to the contents of the funnel and the funnel shaken vigorously. The amyl alcohol layer containing the red $Fe(CNS)_3$ was drawn off and compared with an iron standard prepared in the same way and of about the same color intensity. McFarlane (6) has shown that satisfactory color matches are secured on iso-amyl alcohol solutions containing 0.007–0.022 mg. Fe. Our results have fallen close to the lower limit of these figures and we have had no difficulty in color matches.

In Table 1 are given a series of analyses of milk in duplicate showing the precision attainable (usually within 2 per cent) by the method. On such small quantities of the metals concerned, this is extremely good duplication for any method involving colorimetry.

TABLE 1

Duplicability of copper and iron analyses of milk[a]

SAMPLE NO.	MG. PER 1000 G. MILK			
	Cu found mg. (a)	Fe found mg. (a)	Mean Cu	Mean Fe
W 101	0.0171	0.0060	.....	.....
	0.0171	0.0061	0.172	0.302
W 111	0.0866	0.0091	.....	.....
	0.0860	0.0092	0.863	0.457
W 121	0.0246	0.0090	.....	.....
	0.0242	0.0091	0.244	0.453
W 131	0.0229	0.0058	.....	.....
	0.0232	0.0058	0.230	0.289
W 141	0.0226	0.0058	.....	.....
	0.0222	0.0059	0.224	0.293

[a] Colorimetric determination for Cu carried out on residue from 100 g. milk and for Fe from 20 g. milk.

RESULTS

Hot Water Sterilization

The results secured from two series of experiments using hot water at 165–170° F. for sterilization of the pasteurization equipment are given in Table 2. The footnotes to Table 2 which summarize the bacterial counts and methylene blue reduction periods indicate a very low bacterial content which others have shown to be inducive to oxidized flavor. In the table each score on flavor is the average of three judges scoring independently.

TABLE 2

Keeping quality and the copper and iron content of milk pasteurized and cooled in equipment sterilized with hot water

MILK SAMPLE		FLAVOR SCORES				MG. PER 1000 GM. MILK		
No.	Treatment	1 hour	1 day	2 day	3 day	Copper	Iron	Total
W 10	Raw	22.8	22.3	21.2	22.1	0.172	0.302	0.474
W 11	Past. 0–25 lbs.	23.0	22.5*	17.0*	17.5*	0.863	0.457	1.320
W 12	Past. 25–50 lbs.	23.0	23.0	21.0*	17.8*	0.244	0.453	0.697
W 13	Past. 50–100 lbs.	23.0	22.8	22.8	21.8	0.230	0.289	0.519
W 14	Past. 100–200 lbs.	23.0	23.0	22.8	22.3	0.224	0.293	0.517
W 15	Past. 200–300 lbs.	22.7	23.0	22.8	22.3	.....	.....	.....
W 16	Past. 300–400 lbs.	23.0	22.8	23.0	22.5	.....	.....	.....
W 20	Raw	22.4	22.2	22.8	22.2	0.104	0.324	0.428
W 21	Past. 0–25 lbs.	22.5	21.3*	19.8*	19.3*	0.223	0.345	0.568
W 22	Past. 25–50 lbs.	22.8	23.0	22.7	21.9*	0.157	0.325	0.482
W 23	Past. 50–100 lbs.	23.0	22.8	22.7	22.2*	0.146	0.319	0.465
W 24	Past. 100–200 lbs.	23.0	23.0	22.8	22.8	0.153	0.324	0.477
W 25	Past. 200–300 lbs.	23.0	23.0	22.8	22.7	.....	.....	.....
W 26	Past. 300–400 lbs.	23.0	23.0	22.8	22.8	.....	.....	.....

* Oxidized according to at least two of the three judges.

W 10—Plate count 2,300 to 7,200; methylene blue reduction time 11 to 16 hours; 5.1 per cent fat.

W 11–W 16—All plate counts were less than 100; methylene blue reduction time 17 to 22 hours.

W 20—Plate count 4,900 to 7,600; methylene blue reduction time 17 to 19 hours; 5.2 per cent fat.

W 21–W 26—All plate counts were less than 100; methylene blue reduction time 17 to 26 hours.

It will be noted that the raw milk and the hot milk which passed through the equipment after the first 50 pounds had been through, kept well for three days without the development of oxidized flavor. All samples of milk were of excellent flavor when one hour old. However, the first 25 pounds of milk through the equipment developed a trace of oxidized flavor in one day and was bad in two days. The second 25 pounds of milk through the equipment developed an oxidized flavor in two or in three days. It should

be borne in mind that the tendency of this milk to develop the oxidized flavor was accentuated by the passage through only four feet of piping and over a tubular cooler.

The iron and copper content of the milk markedly increased by exposure to the metal but the increase was very small after the first 50 pounds of milk had passed over the cooler.

It is evident that removal of the first 25 pounds of milk from the milk supply would have materially reduced the copper and iron content of the remainder of the milk and the tendency to become oxidized. The first 25 pounds of milk through the equipment had a copper and iron content of 1.32 parts per million. After 100 pounds of milk had been cooled the copper and iron content of the milk was practically identical with that of the raw milk that had never come in contact with these metals. Apparently the cold milk did not remove appreciable amounts of these metals from the tinned copper, bronze, alloy, and 18–8 stainless steel with which it came in contact for 15 to 30 minutes.

TABLE 3

Keeping quality and the copper and iron content of milk pasteurized and cooled in equipment sterilized with a chlorine solution

MILK SAMPLE		FLAVOR SCORES				MG. PER 1000 GM. MILK		
No.	Treatment	1 hour	1 day	2 day	3 day	Copper	Iron	Total
C 10	Raw	22.0	21.8	22.2	20.8	0.155	0.456	0.611
C 11	Past. 0–25 lbs.	19.5**	17.3*	15.3*	15.3*	0.335	0.675	1.010
C 12	Past. 25–50 lbs.	21.8	22.1	17.3*	16.6*	0.313	0.550	0.863
C 13	Past. 50–100 lbs.	23.3	22.5	21.2	16.6*	0.245	0.537	0.882
C 14	Past. 100–200 lbs.	23.3	22.8	22.5	19.0*	0.203	0.537	0.740
C 15	Past. 200–300 lbs.	23.3	22.5	22.0	18.7*	.....	.....	.....
C 16	Past. 300–400 lbs.	23.5	22.8	22.2	20.8*	.....	.....	.....
C 20	Raw	22.8	21.8	21.5	21.2	0.096	0.363	0.459
C 21	Past. 0–25 lbs.	21.0**	16.8*	17.6*	14.3*	0.177	0.451	0.628
C 22	Past. 25–50 lbs.	22.7	22.2*	20.7*	20.2*	0.155	0.369	0.524
C 23	Past. 50–100 lbs.	23.5	22.3	21.0	21.1*	0.137	0.370	0.507
C 24	Past. 100–200 lbs.	23.5	22.8	22.0	21.5	0.121	0.366	0.487
C 25	Past. 200–300 lbs.	23.0	22.8	22.0	21.3	.....	.....	.....
C 26	Past. 300–400 lbs.	23.3	22.5	22.0	21.8	.....	.....	.....

* Oxidized according to at least two of the three judges.

** Medicinal or antiseptic (coal tar flavor).

C 10—Plate count 2,000 to 2,800; methylene blue reduction time 18 to 23 hours; 4.85 per cent fat.

C 11–C 16—All plate counts were less than 100; methylene blue reduction time 21 to 30 hours.

C 20—Plate count 2,500 to 3,500; methylene blue reduction time 18 to 23 hours; 5.65 per cent fat.

C 21–C 26—All plate counts were less than 100; methylene blue reduction time 20 to 26 hours.

CHLORINE STERILIZATION

The results secured from two series of experiments using a chlorine solution for the sterilization of the pasteurization equipment are given in Table 3. The bacterial contents of the raw and pasteurized milks were very low as indicated by agar plate counts and methylene blue reduction periods.

As in the previous experiments the raw milk kept well and did not become oxidized. The first 25 pounds of hot milk which passed through the equipment was almost unfit to drink within one hour due to an objectionable coal tar flavor. This milk was so strongly oxidized in one day that it was no longer suitable for consumption. The next 25 pounds of hot milk to pass through the equipment was strongly oxidized in two days and milk subsequently secured remained good in flavor for two days. There was a tendency, however, for all of this milk to be poorer in flavor than other milk after a storage of three days.

TABLE 4

Keeping quality and the copper and iron content of milk pasteurized and cooled in equipment sterilized with a chlorine solution and rinsed with hot water

MILK SAMPLE		FLAVOR SCORES				MG. PER 1000 GM. MILK		
No.	Treatment	1 hour	1 day	2 day	3 day	Copper	Iron	Total
R 10	Raw	22.8	22.5	21.5	22.1	0.104	0.517	0.621
R 11	Past. 0–25 lbs.	22.8	21.0*	18.0*	17.0*	0.296	0.810	1.106
R 12	Past. 25–50 lbs.	23.0	23.0	22.0	20.2*	0.197	0.585	0.782
R 13	Past. 50–100 lbs.	23.0	23.0	22.3	21.5*	0.194	0.580	0.774
R 14	Past. 100–200 lbs.	22.8	23.0	22.2	22.8	0.194	0.580	0.774
R 15	Past. 200–300 lbs.	23.0	23.0	22.7	22.8	.....	.....	.....
R 16	Past. 300–400 lbs.	22.7	23.0	22.3	22.8	.....	.....	.....
R 20	Raw	22.8	22.5	22.8	22.0	0.153	0.313	0.466
R 21	Past. 0–25 lbs.	22.8	20.3*	18.8*	20.0*	0.402	0.387	0.789
R 22	Past. 25–50 lbs.	23.0	23.0	22.8	22.2*	0.302	0.355	0.657
R 23	Past. 50–100 lbs.	22.8	23.0	23.0	22.7	0.256	0.315	0.571
R 24	Past. 100–200 lbs.	22.7	23.0	23.0	22.4	0.222	0.310	0.532
R 25	Past. 200–300 lbs.	23.0	22.8	23.0	23.0	.....	.....	.....
R 26	Past. 300–400 lbs.	23.0	23.0	23.0	22.8	.....	.....	.....

* Oxidized according to at least two of the three judges.

R 10—Plate count 2,900 to 5,200; methylene blue reduction time 15 to 22 hours; 5.3 per cent fat.

R 11–R 16—All plate counts were less than 100; methylene blue reduction time 15 to 24 hours.

R 20—Plate count 2,200 to 4,400; methylene blue reduction time 15 to 20 hours; 5.1 per cent fat.

R 21–R 26—All plate counts were less than 270; methylene blue reduction time 25 to 25 hours.

Contrary to expectations the iron and copper contents of the milks were practically identical to those of milks produced by hot water sterilization and there was no probability of explaining the differences in flavor on the basis of increased metal content of the milk.

In the experiments reported in Table 4, the chlorine solution acted on the metal of the equipment for five minutes and was then rinsed out with hot water. The bacterial content of the milk was again very low. A survey of the flavor scores indicates that the milk was of a flavor comparable to that secured by hot water sterilization. Only the first 25 pounds of hot milk through the equipment became oxidized in one day and the second 25 pounds of milk became oxidized in three days. At the end of three days all of the milk cooled subsequent to the first 50 pounds was of good flavor like the milk which passed through equipment sterilized by hot water only.

COPPER AND IRON CONTENT OF MILK

There are many references in the literature to the iron and copper content of milk as secreted by the cow and in market milk. The data secured in this study are of special interests as the newer methods of analyses were employed and the milk was not exposed to these two metals until it was ready for processing. The raw milk represents the actual composition as secreted by the cow. In the pasteurized samples if the first 100 pounds through the equipment were discarded, the analyses of pasteurized milk represent the lowest metal content that could be secured with the metal equipment used in these experiments.

The results of the six experiments are given in Table 5. The raw milk contained an average of 0.131 parts per million of copper and 0.379 p.p.m. of iron. These results are much lower than those in the literature but they compare very favorably with the copper content of milk found by Conn, Johnson, Trebler, and Karpenko for milk obtained directly in glass con-

TABLE 5

The copper and iron content of raw and laboratory pasteurized milk expressed as milligrams per 1,000 grams of milk

SAMPLE	RAW		PASTEURIZED*		INCREASE DUE TO PASTEURIZATION	
	Copper	Iron	Copper	Iron	Copper	Iron
1	0.172	0.302	0.224	0.293	0.052	−0.009
2	0.104	0.324	0.153	0.324	0.049	0.000
3	0.155	0.456	0.203	0.537	0.048	0.081
4	0.096	0.363	0.121	0.366	0.025	0.003
5	0.104	0.517	0.194	0.580	0.090	0.063
6	0.153	0.313	0.222	0.310	0.069	−0.003
Average	0.131	0.379	0.186	0.401	0.055	0.022

* The results given represent minimum values secured after 300 pounds of milk had passed through part of the equipment.

tainers. As a result of processing the milk the copper content was increased 0.055 p.p.m. and the iron content 0.022 p.p.m. These small increases indicate that large contaminations as frequently reported can be avoided.

DISCUSSION

The development of the oxidized flavor in milk in these experiments was accelerated by contact of hot milk within a copper-iron-nickel alloy sanitary pipe and to the outer surface of a tinned copper cooler. The copper and iron content of the first hot milk through the equipment was approximately doubled by such exposure irrespective of the method of sterilization of the equipment but the oxidized flavor was intensified to the greatest degree by chlorine sterilization not promptly followed by rinsing with hot water.

Exposure of the cold milk to the same type of metals produced no detectable increase in copper and iron in the milk and no tendency toward oxidized flavor.

It is evident that the metal itself was of major importance in these studies as exposure of hot milk to stainless steel in the pasteurizing vat did not increase the iron content of the milk or the tendency to become oxidized, irrespective of the method of sterilization.

Although it is true that increased copper and iron contents were associated with oxidized flavor, nevertheless other factors are involved as the rapidity with which this off-flavor developed and the intensity of the flavor could not be correlated with the increase in the metal content. Apparently the amount of copper and iron required to accelerate the oxidation is very small and somewhat larger amounts are of minor significance or, as is probably the case, the contact of the milk with the metal is of greatest importance. It is known that undissolved metal may catalyze reactions and it would be expected that chlorination of a copper-iron nickel alloy would clean the metal surface to give most intimate contact with the milk. After some milk had passed through the equipment there would be a protective milk coating which would reduce contact of metal and milk.

It has been clearly established with milk and ice cream by other investigators that copper added in substantial amounts does produce the oxidized flavor but the flavor may develop without exposure of milk to metals. That the tendency for milk to become oxidized in flavor is characteristic for milk of individual cows even when not exposed to metals has been clearly demonstrated by Guthrie and Brueckner (7).

Samples of the first milk from the pasteurizer over the cooler were taken at two commercial milk plants. In the one plant the equipment was chlorine sterilized followed immediately by a hot water rinse. The sanitary piping and cooler were made of tinned copper in good condition inside. The first milk through this equipment developed the oxidized flavor somewhat sooner than the remainder of the milk but the difference was slight, probably due to tin being a poor catalyst for oxidations. In the other plant

the sanitary piping was aluminum and the cooler was tinned copper without exposed copper. This equipment was sterilized with hot saline solution followed by the hot milk, part of which served to flush the equipment. In this plant the first milk into the bottle kept as well as milk cooled later, a result to be expected. It is interesting to note, however, that milk from both plants became mildly oxidized in flavor in two days whereas the milk used in the other experiments reported in this paper was usually not oxidized in three days.

CONCLUSIONS

Exposure of milk at the pasteurization temperature to certain metals increased the iron and copper content of the milk and greatly accelerated the development of oxidized or cappy flavor. The solution of metals was not affected, in these experiments, by the method of sterilization of the equipment but the development of oxidized flavor was most pronounced when chlorine sterilization was employed. Hence, the amount of dissolved copper and iron was not the only factor involved in the development of oxidized flavor. If the first hot milk through the equipment was discarded the pasteurized milk which showed a decreased tendency to become oxidized especially if the equipment was sterilized with hot water or if chlorine sterilization was followed promptly by a hot water rinse. The intensity of oxidized flavor secured in experiments of this character was shown to be greatly affected by the type of metal, and the type of chlorine solution should also affect the results.

Milk as secreted by the cow contained 0.131 parts per million of copper and 0.379 parts per million of iron. After pasteurization of the milk and after the first milk through the equipment was discarded the copper content of pasteurized milk was 0.186 p.p.m. and the iron content was 0.401 p.pm. These data are relatively low when compared with other data in the literature.

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THE DETERMINATION OF MOISTURE IN POWDERED MILK BY THE TOLUOL DISTILLATION METHOD

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Ever since Bidwell and Sterling (17) developed the toluol distillation method for the determination of moisture in organic materials, and applied it to a limited extent to powdered milk, there has been an interest in its application to the routine determination of moisture in powdered milk. The ease of operation, direct reading and rapidity of obtaining results appealed to the control operator. Wright (2) pointed out that there was some danger of obtaining results that were too high, if the heating was unduly prolonged. Thompson, Slemmons and Fleming (3) and Thompson, Johnson and Kloser (4) recommended this method for control work and gave the details of procedure. The American Dry Milk Institute (5) gives this as the method they prefer for dry skim milk powder.

In view of the increasing interest in the use of this method, it seemed wise to again consider its accuracy. A series of samples of spray process, vacuum roller and atmospheric roller milk powders, both skim and whole, was obtained and these were carefully tested for moisture both by the toluol distillation method and the vacuum oven method. The latter was taken as a standard for comparison as it has generally been considered satisfactory and has been accepted as "tentative" by the Association of Official Agricultural Chemists (6).

The aim of this investigation was to determine the correct period of distillation to obtain the most satisfactory and consistent results by the toluol distillation method; to find out if the toluol distillation method would give results that would satisfactorily check those obtained by the vacuum oven method and to determine the limit of experimental error occurring in the same and different laboratories using the both methods.

SAMPLES AND THEIR PREPARATION

Five separate batches of each of four different types of milk powders were selected. A master sample was prepared by sifting the powder through a 20 mesh copper screen into a large tin container with cover which permitted the sample to be intimately mixed by turning the can end over end and rotating about fifty times. Similar samples were prepared as duplicates of the master sample by transferring the powder immediately after mixing to one pound double friction top covered cans. The covers were placed on the cans immediately and the top and bottom of each can was dipped in paraffin. When each can was opened for experimental work, the

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TABLE 1

The influence of size of sample and time of heating upon moisture tests in percentage

Vacuum Oven Method	(Sample A)	2.58%		2.52%		2.51%		Average—2.54%	
	Time of Dist. in Mins.	*10 Grams*		*20 Grams*		*30 Grams*		*50 Grams*	*100 Grams*
Toluol Dist. Method (Sample A)	10	0	0	0	0	1.27	0.67	0.80 0.40	0.20 0.25
	20	1.20	1.00	2.00	2.25	1.67	2.00	1.90 1.90	1.77 1.72
	30	1.50	1.00	2.25	2.50	2.00	2.27	2.16 2.26	2.10 2.00
	40	1.80	1.80	2.25	2.50	2.50	2.33	2.36 2.40	2.45 2.45
	50	2.00	2.00	2.50	2.65	2.53	2.40	2.50 2.50	2.55 2.55
	60	2.00	2.00	2.50	2.75	2.67	2.50	2.56 2.56	2.62 2.55
	75	2.00	2.00	2.50	2.75	2.67	2.50	2.60 2.60	2.62 2.55
	% Moist. 20° C.	1.70	1.80	2.50	2.65	2.57	2.53	2.56 2.56	2.68 2.63
	Average	1.75		2.58		2.55		2.56	2.66
Toluol Dist. Method (Sample B)	10	1.80	1.80	1.0	1.5 1.9	1.57	1.60 1.17	1.00 1.04	0.17 0.30
	20	2.00	2.00	1.6	2.0 2.25	2.07	1.83 1.77	1.60 1.80	1.45 1.55
	30	2.20	2.10	1.7	2.2 2.35	2.30	2.17 1.87	1.80 1.90	2.10 2.15
	40	2.30	2.20	1.9	2.4 2.4	2.37	2.33 2.00	2.30 2.20	2.40 2.40
	50	2.30	2.20	2.0	2.4 2.5	2.40	2.37 2.07	2.40 2.40	2.45 2.53
	60	2.30	2.20	2.1	2.4 2.5	2.50	2.43 2.33	2.50 2.54	2.50 2.60
	75	2.40	2.20	2.2	2.5 2.5	2.50	2.50 2.33	2.60 2.60	2.60 2.65
	% Moist. 20° C.	2.30	2.20	2.0	2.4 2.35	2.33	2.50 2.33	2.56 2.56	2.56 2.65
	Average	2.25		2.28		2.39		2.56	2.60
Vacuum Oven Method	(Sample B)	2.40%		2.39%		2.43%		Average—2.41%	

analysis was completed as soon as possible so as to minimize the chance of moisture absorption.

METHODS EMPLOYED

(a) The Vacuum Oven Method for moisture was carried out in strict accordance with the outline for this method as given in the Third Edition of "Methods of Analysis, A. O. A. C.," each sample being dried to constant weight.

(b) The Toluol Distillation Method was carried out as described by Thompson, Johnson and Kloser (4), using the equipment recommended and following the procedure in every detail.

SIZE OF SAMPLES AND TIME OF HEATING FOR TOLUOL DISTILLATION METHOD

In an effort to determine the most satisfactory amount of powder to use in the toluol distillation method and the optimum time of distillation, two samples of spray process skimmilk powder were selected and designated as samples A and B. Moisture was determined in duplicate on 10, 20, 30, 50 and 100 gram portions. Distillation was carried on in the regular manner and the percentage moisture recovered was observed at the end of 10, 20, 30, 40, 50, 60 and 75 minutes. The final reading for the volume of water in the receiving tubes was made at 20° C. after 75 minutes' distillation. The percentage moisture was also determined on samples A and B by the vacuum oven method. These results are tabulated in Table 1.

A second series of tests were run, varying the time only. The amount of powder used was 50 grams. Three powders were used, a spray process whole milk designated as C and two roller process skimmilk powders designated as D and E. Four distillations were made on each sample for 1 hour, 1¼ hours, 1½ hours and 2 hours, respectively. Tests by the vacuum oven method were made in duplicate. The results are given in Table 2.

TABLE 2

The time required for distillation using a 50-gram sample

Toluol distillation method			
TIME OF HEATING	SAMPLE C Spray Whole	SAMPLE D Roller Skim	SAMPLE E Roller Skim
1 hr.	2.30	2.72	3.54
1¼ hrs.	2.34	2.90	3.54
1½ hrs.	2.36	3.00	3.64
2 hrs.	2.44	2.94	3.72
Vacuum oven method			
	2.22 – 2.26	2.84 – 2.83	3.54 – 3.53

ABSORPTION OF MOISTURE DURING WEIGHING

The extent to which moisture is absorbed during the weighing of samples for the toluol distillation method was determined by exposing a 50 gram

sample of spray process skimmilk powder to the atmosphere of the laboratory in an uncovered metal dish, approximately 3½ inches in diameter. The powder was spread over the entire surface evenly so that a uniform area would be exposed. At intervals of 5 minutes, the sample was weighed and mixed thoroughly to expose a new surface. These results are given in Table 3A.

Another method of determining moisture absorption was used in which 50 gram samples of the powder were spread evenly on sheets of paper to cover and area of approximately 42 square inches. One sample was immediately transferred to an Erlenmeyer flask and covered with toluol. The remaining five samples were transferred to Erlenmeyer flasks and covered with toluol after standing 5, 10, 15, 20 and 25 minutes respectively. The percentage of moisture recovered is given in Table 3B.

TABLE 3A

Absorption of moisture through exposure of powder in dish to atmosphere of 68% relative humidity

TIME OF EXPOSURE	INCREASE IN WEIGHT, GRAMS	INCREASE EXPRESSED AS PERCENTAGE
0 min.	50.0000	
5 min.	50.0127	0.0254
10 min.	50.0178	0.0356
15 min.	50.0206	0.0412
20 min.	50.0222	0.0444

TABLE 3B

Absorption of moisture through exposure of powder spread on paper

TIME OF EXPOSURE	MOISTURE CONTENT
0 min.	2.98%
5 min.	3.06%
10 min.	3.28%
15 min.	3.30%
20 min.	3.40%
25 min.	3.30%

RESULTS OBTAINED IN DIFFERENT LABORATORIES

In order to determine whether different laboratories would secure substantially the same results on duplicate samples, a series of dry whole and skimmilk powders were prepared from the different methods of manufacture and five master samples of each type obtained. From these master samples, duplicate samples of 300 grams each, were prepared and two of each series were sent to two different laboratories. The moisture content was determined by both methods in triplicate on each sample in each laboratory. The results are given in Table 4.

TABLE 4

Comparison of moisture percentage secured by two different laboratories on the same samples of powder

Atmospheric roller skim powder

SAMP. NO.	VACUUM OVEN METHOD			TOLUOL METHOD		
	Lab. A	Lab. B	Average	Lab. A	Lab. B	Average
1.	2.72	2.89	2.81	2.75	2.77	2.76
2.	3.57	3.69	3.63	3.59	3.60	3.60
3.	2.85	2.77	2.81	2.89	2.77	2.83
4.	3.95	3.97	3.96	3.95	3.94	3.95
5.	3.88	3.93	3.91	3.95	3.88	3.92
Spray process skim						
6.	2.31	2.31	2.31	2.29	2.27	2.28
7.	3.21	3.25	3.23	3.17	3.22	3.21
8.	2.50	2.61	2.56	2.56	2.63	2.60
9.	2.81	2.76	2.79	2.77	2.77	2.77
10.	2.37	2.44	2.42	2.40	2.47	2.44
Spray process whole powdered milk						
1.	2.13	2.16	2.15	2.01	2.12	2.07
2.	2.03	1.99	2.01	1.93	2.05	1.99
3.	2.10	2.06	2.08	1.94	2.05	2.00
4.	2.10	2.12	2.11	1.97	2.09	2.03
5.	1.84	1.86	1.85	1.83	1.76	1.80
Vacuum drum skim						
1.	3.05	3.13	3.09	3.01	3.01	3.01
2.	2.82	2.82	2.82	2.89	2.81	2.85
3.	2.55	2.63	2.59	2.77	2.67	2.72
4.	2.88	3.01	2.95	2.86	2.97	2.92
5.	2.73	2.87	2.80	2.84	2.89	2.87

DISCUSSION

It is apparent from the results given in Table 1 that a ten gram sample gives low results with the toluol distillation method. The reason for this is not clear but it may be due to the small size of the sample as compared with the large capacity of the equipment. A 20, 30, or 50 gram sample gives results which check very well with those obtained by the oven method, the greatest variation being 0.15%. A 100 gram sample gives fairly satisfactory results, but because of requiring constant attention to prevent burning it is not recommended. For reasons of uniformity, it seems desirable to settle on 50 grams as the standard amount to use.

Tables 1 and 2 indicate that a distillation period of less than 60 minutes is insufficient. A distillation period of more than 60 minutes is sometimes necessary. When additional moisture comes over between 50 and 60 minutes, the distillation should be continued to 75 minutes as a limit.

The results given in Tables 3A and 3B indicate the ease with which milk powders will absorb moisture. Moisture may be absorbed from the air or

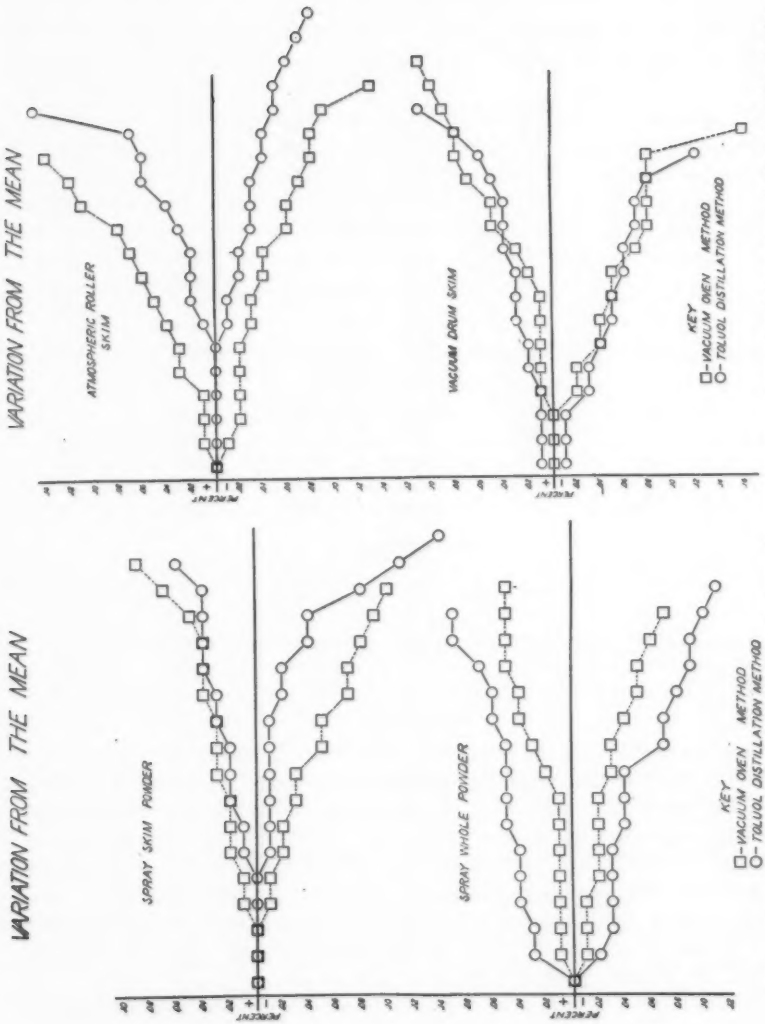

FIG. 1. The variations of each individual test from the average percentage of moisture secured by both laboratories.

from the paper on which the powder is weighed. The practice of mixing large samples on sheets of ordinary paper is undesirable. Moisture samples should be weighed out as quickly as possible when using either method and in the toluol distillation method, they should be covered immediately with toluol after weighing.

Table 4 gives the results as obtained on all samples in the different laboratories and shows very satisfactory agreement.

Figure 1 shows the variation from the mean for each individual test obtained from both laboratories by both methods. The variations in results from the mean are no greater by one method than by the other which justifies the conclusion that the toluol distillation method for milk powder is entirely satisfactory.

CONCLUSIONS

1. A 30- or 50-gram sample is satisfactory for determining moisture by the toluol distillation method. For the sake of uniformity, the 50-gram sample is recommended.

2. The time of distillation should not be less than 60 minutes. It may be necessary, in some cases, to continue the distillation for 75 minutes. Prolonged distillation up to 1½ hours may result in a disintegration of the powder which is evidenced by considerable discoloration.

3. Milk powders absorb moisture when exposed to the atmosphere which makes it necessary to prepare and weigh out samples as quickly as possible.

4. The toluol distillation method has four distinct advantages:

   a. It enables the use of a large size sample.
   b. Each determination can be completed in about one hour.
   c. It is readily adapted for plant control work.
   d. It is just as accurate as the vacuum oven method.

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STUDIES ON THE EMULSIFYING SALTS USED IN PROCESSED CHEESE*

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In the manufacture of processed cheese certain salts are used for the purpose of preventing the separation of fat from the cheese and at the same time giving the finished product the desired body and texture. For want of a better name these salts are known as emulsifiers. In previous papers (1, 2) various researches on processed cheese have been described in which sodium citrate, sodium-potassium tartrate or Rochelle salt, and the disodium salt of orthophosphoric acid were used as the emulsifying salts. In the meantime a number of European investigators have published their results in which they confirm the statement that at the present time sodium citrate is the most satisfactory emulsifying agent for the manufacture of processed cheese. Thus in a paper on the use of sodium metaphosphate Umbreht (3) compares cheese made with this emulsifier with that made with sodium citrate, the latter being taken as the standard.

Habicht (4) has presented a very comprehensive study of the salts that may be used as emulsifiers; he concludes that the ideal emulsifying salt combines an alkaline monovalent cation with a polyvalent anion, *i.e.*, a tri- or quadrivalent anion. To illustrate the importance of the valence of the anion, Habicht (5) states that the relative emulsifying properties of sodium acetate, disodium tartrate, and trisodium citrate are 1:20:100. Habicht (4) found that tetrasodium pyrophosphate and tetrasodium ferrocyanide were very satisfactory emulsifying salts, although their effectiveness was not as great as might be anticipated from an extrapolation of the above ratio. The ferrocyanide is only of theoretical interest since its toxicity precludes its use. The cations with a higher valence than unity were found to be unsatisfactory even when combined with a trivalent anion. Of the various monovalent, alkaline cations, potassium or lithium tend to impart a very characteristic and peculiar flavor to the resulting product such as is common with all their salts. Between sodium and ammonium salts the former would be preferable on the basis of flavor.

Habicht (4) seeking a physico-chemical explanation of emulsifiers advances the view that under the influence of heat and agitation certain combinations take place within the cheese mass. He suggests that there is a partial saponification between the cation of the salt and the fatty acids, and that the anion, which is a solvent for casein, combines with this portion of

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the cheese in such manner that there is a film of casein surrounding each fat globule to prevent the escape of fat from the cheese mass.

It is known that there are combinations of cheese which may be heated without the use of an emulsifier and from which there will be no appreciable escape of fat. Other combinations will lose fat rapidly and this fat may never be completely re-incorporated in the cheese mass when heated without the use of emulsifiers. This phenomenon seldom occurs when an emulsifier is used so that its appearance is direct proof of a poor selection of cheese and the use of the wrong type of emulsifying salt. When emulsifiers are used there may be some separation of fat in the early stages of the process, but the fat is re-incorporated as the heating continues so that the final product is homogeneous with no evidence of free fat. Of the number of salts that have been suggested as emulsifying agents only a few have proved to be of practical interest. Many have only a theoretical interest because of some inherent property which they possess, for example, toxicity. The suggestion has been made (6) that the number of hydroxyl groups in an organic hydroxy acid is responsible for the emulsifying action of that particular salt; thus one might enumerate a number of salts that offer possibilities as emulsifying agents for processed cheese.

This paper presents a comparison of potassium citrate, tetrasodium pyrophosphate, sodium metaphosphate and a fusion mixture of equal parts of the mono- and disodium salts of orthophosphoric acid with sodium citrate. Another comparison involving salt and the disodium salt of orthophosphoric acid with sodium citrate is included. The salts were used separately in amounts ranging up to 5 per cent for the pyro- and metaphosphates and the sodium citrate. Three per cent of potassium citrate was the maximum because it was noted that this concentration had a noticeable effect upon the flavor of the cheese. Due to the limited cheese supply only two samples were made with the phosphate fusion mixture although tests with other cheese indicated that two per cent is the maximum concentration that could be used on account of the acidic nature of the salt. While the legal maximum for the added salts is three per cent of the weight of the cheese mass it seemed advisable to exceed these limits in order to gain more information on the action of the salts at higher concentrations.

Analyses of the processed cheese samples were made to determine the changes in the ash, total nitrogen, water soluble nitrogen and 5 per cent NaCl soluble nitrogen contents. Other properties studied were the loss of fat from a definite volume of cheese upon standing, and the loss of moisture during a storage period of almost one year. In addition the usual measurements were made for the determination of the pH of the cheese, the titratable acidity and the resiliency as measured by the resistance of one inch cubes of cheese to crushing (1).

The raw material used was a blend of cheddar cheese that ranged in age from about 4 to 13 months, with the average age being approximately eight

TABLE 1

Effect of varying amounts of emulsifying salts on the properties of the processed cheese

SAMPLE NO.	EMULSIFIER		MOISTURE PERCENTAGES			pH DETERMINATIONS WITH QUINHYDRONE		TITRATABLE ACIDITY %	BODY IN GRAMS	FAT LEAKAGE FROM CHEESE. AREA IN SQUARE INCHES
	Kind	%	Average first two	Third	Loss as % of average	Cheese paste	Cheese 1 : 10 suspension			
1	Control		38.88	34.77	10.57	5.43	5.86	1.59	1233	3.53
2	$Na_3C_6H_5O_7$	1.0	40.14	34.86	13.15	5.48	5.97	1.54	849	6.32
3	"	2.0	39.88	36.79	7.75	5.62	6.12	1.26	1087	1.94
4	"	3.0	39.92	37.75	5.44	5.65	6.15	1.30	923	1.77
5	"	4.0	39.58	38.36	3.08	5.78	6.30	1.34	970	1.67
6	"	5.0	39.09	37.35	4.45	5.99	6.37	1.32	1159	0.93
7	$K_3C_6H_5O_7$	3.0	38.64	36.09	6.60	5.68	6.15	1.48	850	2.16
8	"	2.5	38.51	35.55	7.69	5.68	6.19	1.48	1246	1.81
9	"	2.0	38.83	36.24	6.67	5.61	6.12	1.36	953	1.43
10	"	1.5	38.72	36.05	6.89	5.57	6.03	1.58	968	3.14
11	"	1.0	39.19	36.78	6.15	5.55	5.95	1.62	798	5.85
12	$Na_4P_2O_7$	5.0	37.66	34.83	7.51	6.03	6.49	1.42	1025	1.54
13	"	4.0	38.06	35.52	7.19	6.02	6.52	1.58	1229	1.41
14	"	3.0	38.41	36.19	5.78	5.96	6.40	1.42	1255	2.35
15	"	2.0	38.74	35.82	7.54	5.74	6.26	1.68	1171	3.14
16	"	1.0	39.36	36.62	6.96	5.60	6.12	1.31	1361	1.35
17	$NaPO_3$	5.0	38.17	34.18	10.45	5.30	5.80	2.79	1982	2.52
18	"	4.0	38.12	35.41	7.11	5.21	5.65	2.81	2096	3.02
19	"	3.0	37.99	34.51	9.16	5.20	5.68	2.68	2034	3.56
20	"	2.0	38.36	31.16	18.77	5.27	5.72	2.52	1981	3.37
21	"	1.0	38.66	35.32	8.64	5.36	5.78	2.29	1675	2.78
22	NaH_2PO_4	2.0	38.63	33.49	13.31	5.32	5.77	2.01	1704	2.16
23	and Na_2HPO_4	1.0	38.64	35.24	8.80	5.34	5.75	1.98	1102	5.73

months. To insure the thorough mixing of the cheese mass it was ground twice through a power driven food mill. The cheese mass was heated directly with steam, care being taken to open the inlet valve the same amount for each sample and the length of time that the steam was turned on was noted with a stop-watch. In this connection it was interesting to note the difference in steam time necessary to give the cheese mass the same apparent consistency. The samples prepared with sodium citrate required about 6 per cent less time than the others and as will be noted from table 1, these samples had a slightly higher moisture content than the others. With the higher percentages of emulsifiers the cheese mass was more difficult to stir in the kettle because the molten mass had a firmer consistency than those made with the usual amounts of emulsifiers.

Analytical data on the moisture content, the pH as determined by two methods, the titratable acidity calculated as lactic acid, and the body of the cheese as measured by the resistance of one inch cubes to crushing are given in table 1. The data on the moisture content include the average of the first two examinations, made shortly after processing as compared with a third examination made after nearly a year in storage. The pH and titratable acidity values are quite consistent, varying with the type and the amount of emulsifier used in the cheese. The samples made with metaphosphate were highest in acidity with the fusion mixture second. The sodium and potassium citrates are nearly identical for the same concentrations of the salts. As was expected from the acid reaction of the metaphosphate samples, the body of these samples as measured by the resistance to crushing was somewhat greater than the others. In the first column under pH determination the cheese was worked to a paste with quinhydrone while in the second determination the quinhydrone was added to the 1:10 aqueous suspension of the cheese which had been prepared for the titratable acidity determination.

The method used for the determination of moisture in the processed cheese consisted in thoroughly mixing a rather large sample and then weighing out duplicates of about two grams each into 52 mm. porcelain crucibles equipped with porcelain covers. The crucibles were placed in a steam oven with the covers slightly raised to permit the escape of moisture and still prevent any loss of cheese due to spattering. The samples were kept in the oven for four hours with a twenty-inch vacuum being drawn for the last two hours. The crucibles were then removed to a desiccator, cooled and weighed. As longer dehydration periods failed to produce any appreciable changes in the weight of the residue, it was assumed that this method might be used in place of the longer official method. Of course the weight of cheese used is less than with the official method, but with very few exceptions, the duplicate determinations showed very good agreement.

The third examination for the moisture content was made after the samples had been in storage for more than eleven months. All of the samples of cheese were stored under the same conditions of temperature and humidity in the original tinfoil lined boxes, which had the covers nailed on within a few hours after the molten cheese had been filled into the foil. Table 1 shows that the cheese samples suffered considerable moisture loss during the eleven month storage. These results were obtained incidentally, and while, as far as is known, all the samples had equal opportunity for moisture loss, no detailed record was made of the possible factors. While no close correlation is evident between the moisture loss and the amounts and kinds of emulsifying salts used, the results do suggest a possible relation between emulsifying salts and the tenacity with which the moisture is held. This phenomenon may warrant further study.

The total ash of the processed cheese was obtained in the usual manner of ashing the residue from the moisture determination in an electric furnace. As can be seen from Fig. 1, the results were quite in accordance with ex-

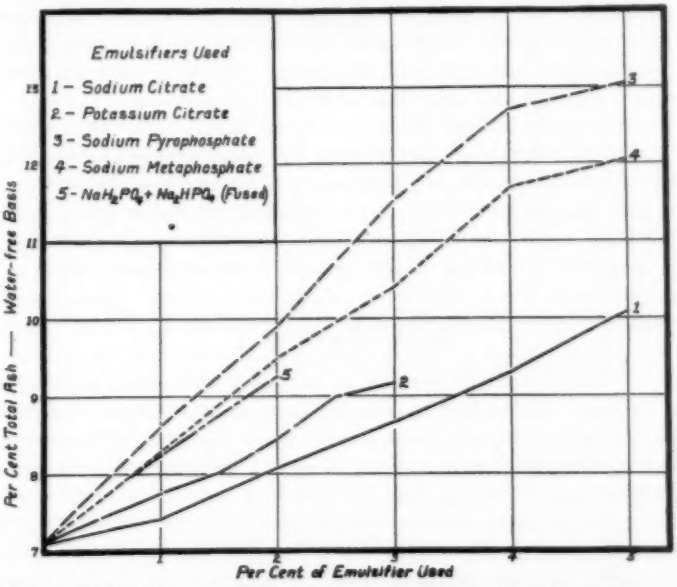

FIG. 1. RELATION OF THE EMULSIFYING SALTS TO THE TOTAL ASH CONTENT.

pectations, namely, the percentage of the ash increased with the amount of emulsifier used. All values are presented on a moisture free basis so as to make them comparable. The total ash was carefully extracted with warm water and then filtered to remove the insoluble portion. The crucible and insoluble residue were washed with water so that the filtrate and washings

were less than 100 cc. The aqueous extract was then made up to 100 cc. and divided into two equal portions. One of these was acidified with 5 cc. of N/14 sulfuric acid, boiled to expel CO_2, cooled and titrated with N/14 NaOH to determine the amount of basic materials in the ash. The results have shown that the increase in basic materials is approximately proportional to the increase in the amount of emulsifier used in the cheese. The second portion of the aqueous extract was titrated with standard silver nitrate using potassium chromate as the indicator, and the results calculated as the per cent of sodium chloride present in the cheese. The results of this determination were quite uniform and consistent for the samples containing either of the citrates or Rochelle salt, but with any of the phosphates the results varied widely, indicating that in order to make a satisfactory determination of the chloride in the presence of phosphates a different ashing procedure must be used. Checks on the method as indicated by the control samples without emulsifiers were very satisfactory. The water insoluble portion of the ash remaining on the filter paper was returned to the furnace and the results of the second ashing expressed as the water insoluble fraction of the total ash. Here again the results showed consistent increases with increasing amounts of emulsifiers when citrates or tartrate were used, but with the phosphates there was no evident correlation.

Determining the leakage of fat from cheese samples is a new test that had its origin in the observation that varying oily areas were left on paper after a number of cheese samples had been laid out for examination and judging. In the first applications of this test the sample of cheese was placed on a piece of filter paper, but this proved to be unsatisfactory as this paper did not show sufficient differentiation; other papers were tried until a white paper was found which gave more satisfactory results. This appeared to be a relatively short fibered paper as the fat spread quite uniformly in all directions from a piece of cheese placed in the center of the paper. The method as finally adopted consists in taking a cylindrical portion of the cheese 0.5 inch thick and 0.71 inch in diameter (0.198 cubic inches) from near the center of the sample with a cork borer. One face of this cylindrical sample (0.396 square inches) is placed in intimate contact with the paper in an incubator at 37.78° C. (100° F.) for two hours. The paper and cheese are then removed to room temperature for twenty hours. At the end of the this time the piece of cheese is removed from the paper which is then held against a pane of glass towards a source of light and the area that has been rendered translucent by the fat is carefully marked off, thereby avoiding difficulties due to further spread of the fat before the area can be measured. While the translucent area is never exactly circular in shape enough measurements can be made so that it is possible to arrive at a rather close approximation of the area. The results are presented in table 1. With one per cent concentration of the citrates and the fusion mixture of the salts

of orthophosphoric acid there is a rather decided loss of fat as compared with the other phosphate samples; at two per cent the situation is reversed and from there on the metaphosphate samples show a greater fat leakage than the others. Sodium citrate showed a continual decrease in the fat loss with increasing emulsifier content while the pyrophosphate showed a slight increase.

The total nitrogen in the various samples of processed cheese was determined by the usual Kjeldahl method. The results are presented in figure 2.

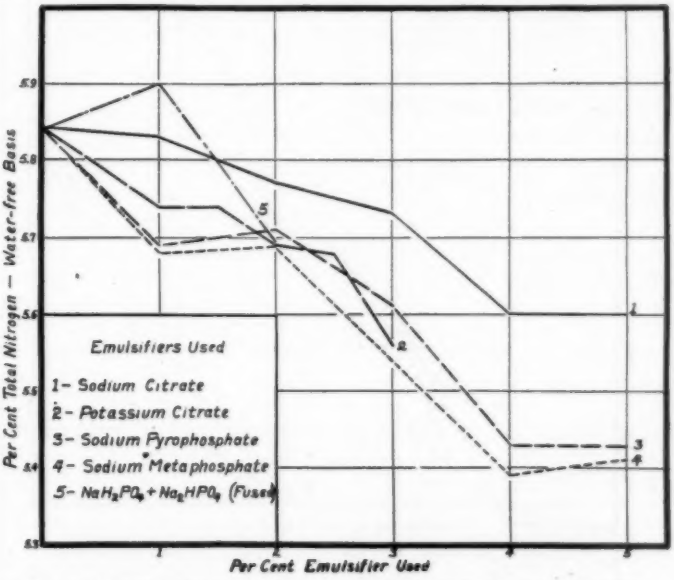

FIG. 2. RELATION OF THE EMULSIFYING SALTS TO THE TOTAL NITROGEN.

From this it is evident that with all of the emulsifiers used the nitrogen percentage of the cheese (water free basis) decreased as the amount of salt increased. The addition of dry matter in the form of salts does not fully account for this decrease. Two possibilities suggest themselves in explanation of this fact. It might conceivably be due to less exhaustive drying in the moisture determinations. It is more likely due to escape of nitrogen as vapors from the cheese mass during the processing operation. Any one who has visited a large chesse processing factory knows that the vapors from the heating units carry away considerable volatile materials.

The water soluble nitrogen in the cheese determined by a modification of the usual method which calls for a 24-hour extraction with occasional shaking, using chloroform to prevent bacterial action. The change consisted in the use of motor driven laboratory stirrers which kept the cheese

and water in vigorous agitation for a period of three and one-half hours. It was felt that this change would give comparable results with a marked saving in time. The results presented in figure 3 show that the water soluble nitrogen increases with the percentage of emulsifying salt used.

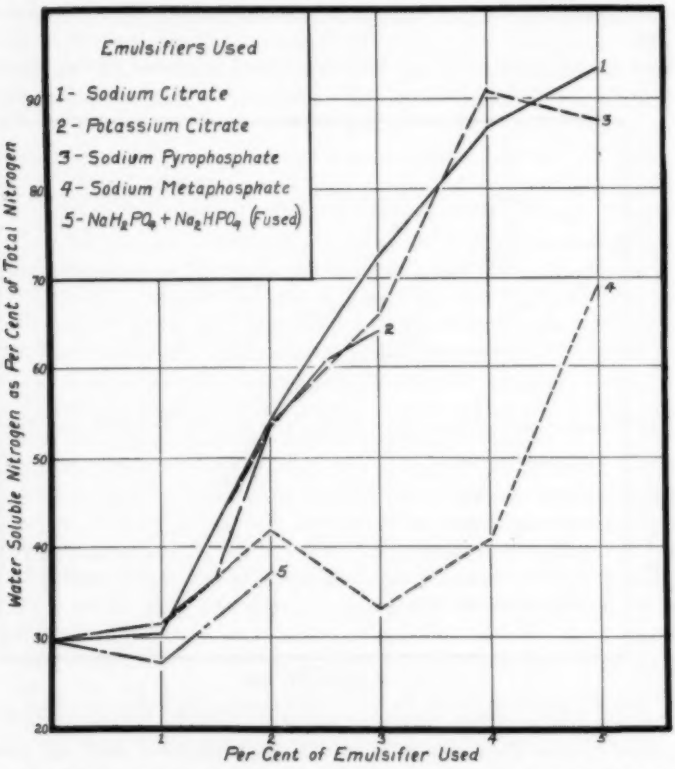

FIG. 3. RELATION OF THE EMULSIFYING SALTS TO THE WATER SOLUBLE NITROGEN.

As might be expected from the results of the study of the water soluble nitrogen in the cheese mass there was not very much nitrogenous matter left to be determined in that fraction which is soluble in a 5 per cent solution of sodium chloride. This is especially true of the samples made up with 4 and 5 per cent of sodium citrate and pyrophosphate as shown in figure 4. Potassium citrate is in excellent agreement with the sodium salt. The metaphosphate gives the cheese a somewhat more acid reaction than the other salts and this is shown in the decrease in the water and salt soluble fractions. The same holds true for the fusion mixture. The effect of these salts is not as pronounced as the addition of acid to the cheese mass in decreasing the

amount of nitrogen that may be found in the water and salt solution fractions. A limited number of experiments have shown that the addition of acids in amounts sufficient to give the cheese a grainy, curdy appearance will reduce the water and salt soluble nitrogen of the cheese very decidedly.

The sum of the water and 5 per cent sodium chloride soluble fractions as per cent of the total nitrogen is shown in figures 5 and 6. The first of these

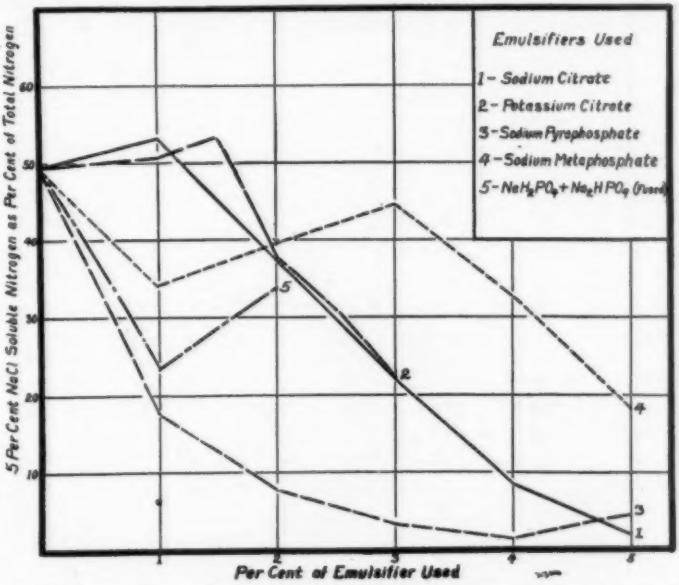
Emulsifiers Used
1 - Sodium Citrate
2 - Potassium Citrate
3 - Sodium Pyrophosphate
4 - Sodium Metaphosphate
5 - $NaH_2PO_4 + Na_2HPO_4$ (fused)
5 Per Cent NaCl Soluble Nitrogen as Per Cent of Total Nitrogen
Per Cent of Emulsifier Used

FIG. 4. RELATION OF THE EMULSIFYING SALTS TO THE 5% NaCl SOLUBLE NITROGEN.

shows that there is relatively little difference between sodium citrate and Rochelle salt, but disodium phosphate (ortho form) shows slghtly lower values. This chart also shows that there is very little difference in the results from the use of direct steam or indirect steam for heating the cheese mass. According to the results shown in figure 6 it is evident that there is very good agreement between the two citrates within the range of comparison although no explanation may be offered at this time for the drop with three per cent of potassium citrate. It is interesting to note that all of the phosphates show a very low value for the sum of the water and 5 per cent sodium chloride soluble fractions with only one per cent of emulsifier, this value however increases rapidly especially at 4 and 5 per cent concentration so that at the latter figure the pyrophosphate has almost the same value as the sodium citrate. Analyses of raw cheese about to be used for processing have indicated that there is some evidence to support a theory that in the comparison of a number of cheeses of the same age, the sum

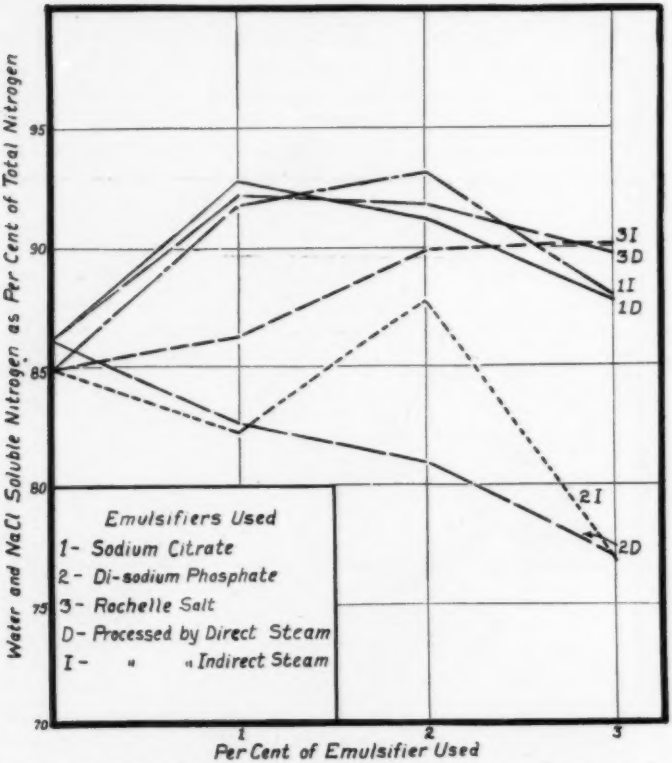

FIG. 5. RELATION OF THE EMULSIFYING SALTS TO THE SUM OF THE WATER AND 5% NaCl SOLUBLE NITROGEN.

of the water and salt soluble nitrogen fractions will be higher for the cheese of the better quality. The data collected hovever are not sufficient to warrant a more definite statement until further analyses have been made involving cheeses of varying ages and degrees of quality.

A study was also made of the changes occurring in the appearance of the tinfoil when it was removed from the cheese samples, but these results will be presented in another paper which will deal specifically with the subject of wrappers or wrapping materials suitable for processed cheese.

A summary of the properties of the various samples as determined by the senses of taste, smell and sight indicated that the samples of cheese made with sodium citrate were the most satisfactory. Potassium citrate gave the cheese an unnatural bitter taste which became more pronounced with storage. When three per cent of this emulsifier was used the cheese had a rather unpleasant aroma, a defect which was also noted when three

per cent or more of the phosphates was used. The samples containing one or two per cent of the pyrophosphate were very satisfactory as regards flavor, but with higher concentrations the cheese had a tendency to be bitter. With the metaphosphate the cheese had a rather sour taste which was not sufficient to be unpleasant, but to the person desiring a mild flavor this cheese might be considered as objectionable. The limited solubility of these two phosphates is a factor that must be considered in their use especially when direct steam heating is employed since it is then necessary to

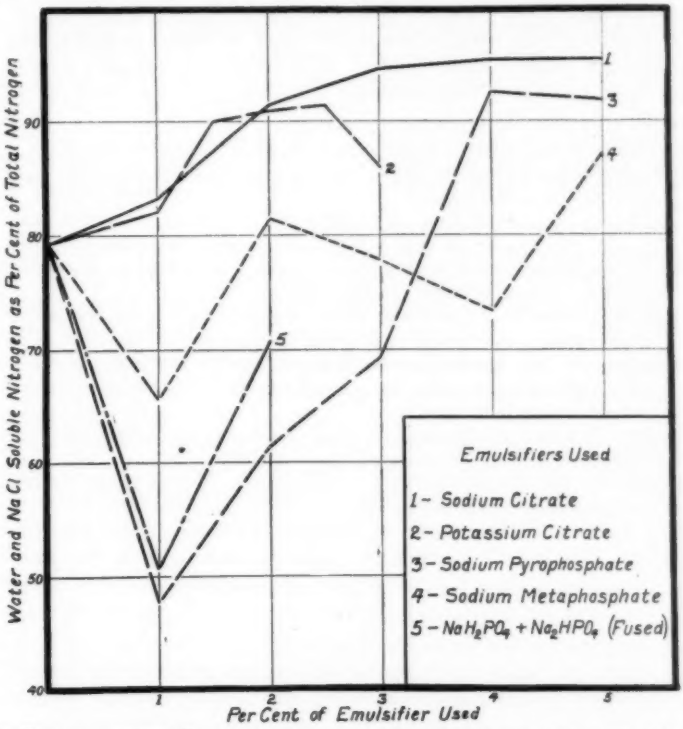

FIG. 6. RELATION OF THE EMULSIFYING SALTS TO THE SUM OF THE WATER AND 5% NaCl SOLUBLE NITROGEN.

add the salts in a dry form. In the last examination of the samples it was noted that all of the samples containing three per cent or more of the pyrophosphate showed large lumps of white, salty material which gave every indication of being a point at which the emulsifier in the cheese had crystallized. These lumps were large enough to cause the surface of the cheese and the tinfoil to bulge out and at the same time cause discoloration of the cheese around them.

One test which is used by the commercial manufacturers of processed cheese is the melting test. In this a definite volume of cheese is placed on a hot plate or the cover of a hot water bath and allowed to melt; the ease with which it melts and spreads over the heating surface is taken as the criterion of desirability for that particular sample of cheese. When either the meta- or pyrophosphates were used the cheese did not melt but lost moisture while retaining its original shape. With the other salts the cheese mass usually spread out until it covered the bottom of the dish in which it was being heated.

The results of this study of emulsifiers may be stated as confirming previous findings, namely that none of the emulsifiers used are superior to sodium citrate and it is very doubtful if any of them are equal to sodium citrate when all the factors are considered.

In conclusion the authors wish to express their thanks to the Chas. Pfizer & Co., Inc., for the fellowship under which this investigation has been conducted.

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EFFECT OF SALTS ON THE SOLUBILITY OF CASEIN AND PARACASEIN

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Initially this investigation had three objectives: first, to study the physico-chemical properties of commercial casein prepared from the same milk by different methods; second, to obtain information bearing on the methods of following the alterations in the protein fractions during cheese ripening; and third, to obtain an independent check on the work of Michaelis and Mendelssohn (8).

Van Slyke and Hart (15) (16) (18), Van Slyke and Bosworth (14), and Bosworth (2) in their studies of the changes in the protein fractions during cheese ripening determined among other things what they termed the "salt soluble protein." They believed that the casein underwent the following sequence of changes during cheese making and ripening: (1) casein, (2) paracasein, (3) protein soluble in warm salt solution, (4) protein insoluble in warm salt solution, (5) water soluble protein, and finally (6) proteoses and small split products. They called attention to the influence of acidity on the formation of the salt soluble protein, and showed that during the first few hours of cheese making practically all of the paracasein is converted into the salt soluble protein.

Orla-Jensen, Meyer and Orla-Jensen (9) found that the solubility of paracasein passed through a maximum when increasing amounts of lactic acid were added to milk previously coagulated with rennin and to which salt had been added. No appreciable increase in solubility was found in the absence of salt or in milk to which no rennet or salt had been added.

Michaelis and Mendelssohn (8) found that paracasein shows two flocculation zones, one at pH 4.5 to 4.6 and another at pH 6.0 to 6.4. Between pH 4.6 and 6.0 and above pH 7.0, the paracasein remained in suspension.

The results presented here indicate that the salt solubility of the protein is merely a reflection of the change in hydrogen-ion concentration of the extracting solution or cheese and that the paracasein can be made salt soluble or salt insoluble at will by changing the pH.

EXPERIMENTAL

The dried samples of the commercial type of rennet, grain curd, sulfuric acid and sulfuric acid cooked curd casein used in this study were prepared by Dr. W. V. Price. The sample of purified casein (ash 0.06%) was prepared by Dr. R. Whitaker. The procedure used in determining the solubility of the casein was patterned after the method of Van Slyke and Hart

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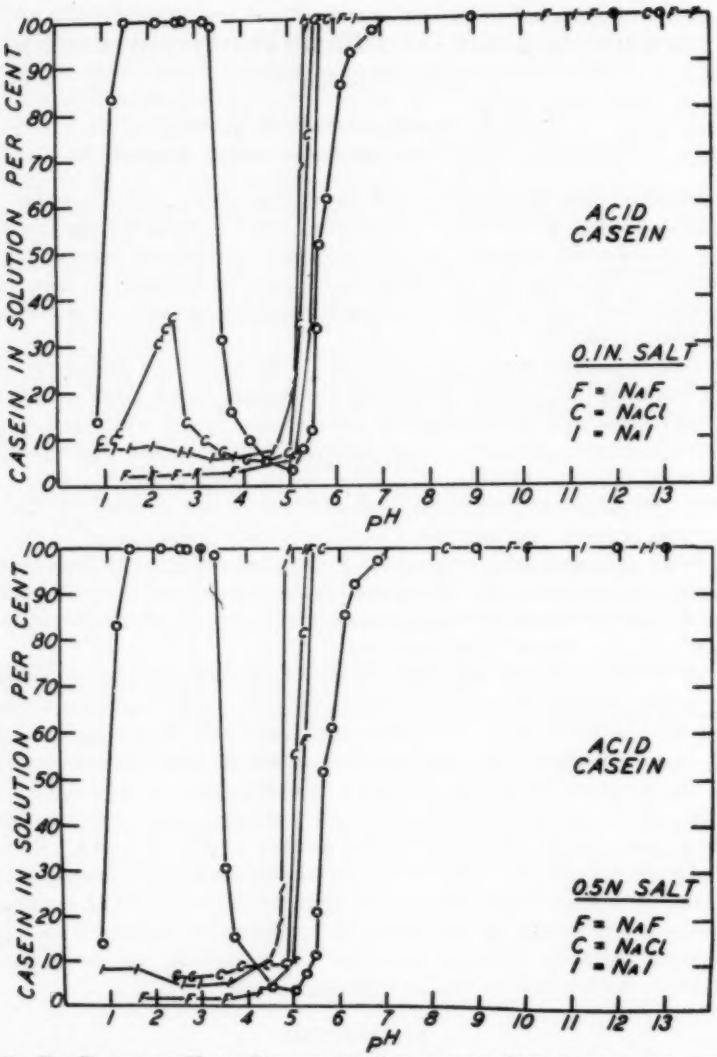

FIG. 1. THE EFFECT OF pH AND SALTS ON THE SOLUBILITY OF CASEIN PRECIPITATED WITH HYDROCHLORIC ACID.

(15) (16) (18). To one gram of the dried casein, 25 ml. of distilled water were added, and the suspension was allowed to stand over night in a refrigerator. The next morning solutions of either HCl or NaOH and the proper amount of a solution of the selected salt were added and the result-

ing mixture was made up to a total volume of 100 ml. The suspension was heated with occasional shaking for one hour in a water bath held at 50–55° C. It was next filtered through a packed cotton pad and the nitrogen in an aliquot of the filtrate was determined by the Kjeldahl method. Another portion of the filtrate was used for the determination of the pH at 25° C.

The solubility curves obtained with the grain curd casein are presented in Figure 1. The data obtained with the other commercial acid caseins as well as the purified casein superimpose almost exactly upon the curves given in Figure 1, and are therefore omitted.

The salts in the order fluoride, chloride and iodide tend to shift the alkaline solubility zone to a more acid region, the shift being greater the higher the concentration of the salt. Sharp and De Tomasi studied this effect on the precipitation of casein from milk, and found that in very high concentrations of sodium chloride, acid must be added until an electrometric pH reading of 2.0 or 3.0 is reached before the casein is precipitated. It is noted that the salts used in Figure 1 reduce or prevent the solution of casein in the region of pH 3.0. These curves were used to predict the effect of pH and salts on the churning time of cream, which resulted in the paper by Guthrie and Sharp (5).

The curves obtained with paracasein (commercial rennet casein) are shown in Figure 2. This type of casein is high in ash and contains appreciable amounts of calcium. In the absence of added salt the zone of insolubility of the paracasein is from pH 4.5 to 7.5. The iodide and particularly the chloride shifted the zone of insolubility further into the alkaline region, the shift increasing with the concentration of the salt added. Sodium iodide and sodium chloride, however, caused a similar displacement of the peptizing zone in the region from pH 5.5 to 4.5 in the case of both the acid and the rennet casein.

Sodium fluoride has long been used as a plasticiser for rennet casein. It shows an anomolous behavior when compared with the chloride and iodide. Calcium fluoride is very slightly soluble. Perhaps the upper half of the curve obtained with sodium fluoride and its plasticising properties toward rennet casein are partly accounted for by the removal of the calcium to form the insoluble calcium fluoride. The upper part of the sodium fluoride curve moves to the right with increasing concentration. In this respect it shows some of the tendencies as shown by the chloride and iodide.

The peptizing effect of the salts on paracasein in the zone between pH 5.0 and 6.5 is of special interest. The iodide is more effective than the chloride. The effect of each increases with the concentration. Figure 2 indicates that if a suitable concentration of sodium chloride between 0.1 and 0.5 normal were selected, the paracasein would show three zones of solubility about as follows: pH 2.5, 6.0 and 9.5. It would show zones of insolubility at pH 1.0, 4.5, 7.0–9.0, and a hypothetical one at 11.5. The zones

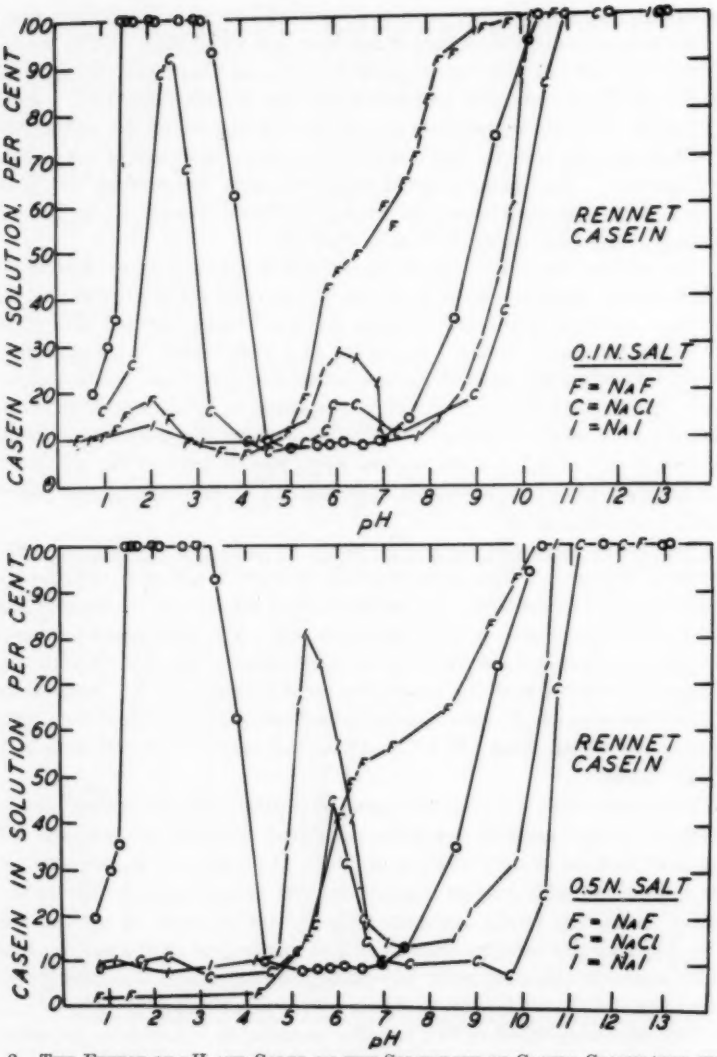

FIG. 2. THE EFFECT OF pH AND SALTS ON THE SOLUBILITY OF CASEIN COAGULATED WITH RENNIN (PARACASEIN).

shift with the concentration of the salt. The curves in Figure 2 are in general agreement with the experiments of Michaelis and Mendelssohn. Bostrom (1) states that calcium paracasein is not precipitated above pH 10.0. Figure 2 indicates that the salt soluble protein determination has

little significance in the measurement of the actual chemical changes in the protein as a result of cheese ripening.

The fact, however, that sodium chloride solutions with pH values near 5.5 to 6.0 disperse paracasein, is of great practical importance in cheese making. Van Dam (13) found that the increased dispersion accelerated digestion by pepsin. On the other hand Van Slyke and Hart (17) found that the actual rate of ripening was inversely related to the salt content. Riddet, Valentine, McDowall and Whelan (10) reached the conclusion that a normal salt content corresponding to 4.82 per cent in the water of the cheese gave the best body. McDowall and Whelan (7) found that concentrations of salt in excess of about 4 per cent retarded the rate of acid production by *Streptococcus lactis*. They are inclined to explain the adverse effect of high salt in cheese ripening as due to retarded bacterial growth. cheddar cheese is usually not salted until it is far along in the making process, when the acid development is well under way and the lactic acid bacteria are present in the curd in large numbers. If the curd is salted before the pH reaches 5, the plasticising effect of the salt on the curd particles should be observed at the time of salting. Some cheese makers use more salt, the higher the fat content of the milk or curd. This would tend to increase the concentration of salt in the water of the cheese. Insofar as ripening is concerned, the concentration of salt in the water is the important thing, and not the amount in the cheese as a whole.

Apparently under some conditions salt may have an adverse effect upon ripening. In many of the studies, however, the moisture content of the cheese has decreased with the increase in salt and has varied during the ripening. In order to compare the effect of salt on texture alone, comparable degrees of ripening and the same moisture content and composition must be assumed.

The curves in Figure 2 suggest that at pH values near 5 and 7 a smooth-textured cheese would not be expected, because at these pH values the unhydrolized paracasein would be insoluble in salt solution. The maximum smoothness should be obtained in the region of pH 5.5 and 6.0, because in this region the paracasein is peptized by salt. Unsalted cheese, however, should not be smooth in this pH region, unless it is overripened.

Davel and Retief (4) concluded that the control of the acidity was the most important factor in the manufacture of processed cheese. The pH-body curves for processed cheese as given by Templeton and Sommer (12) are in agreement with the idea that cheese would be poor in texture at pH zones 5 and 7, and smooth at pH 5.5 to 6.0. Watson (19), Brown and Price (3), and others have shown that in cheese making the pH falls during the first day or two to the region of pH 5 or below, and then during the true ripening the pH very slowly increases and again enters the region (pH 5.5 to 6.0) of maximum dispersion of the paracasein by salt. The pH values

of cheese given by Knudson (6) and Wode (20) fall in the peptizing zone. A number of samples of commercial processed cheese were examined and were found to have pH values from 5.45 to 6.0. These values are in agreement with those published by Templeton and Sommer (11) (12).

This investigation, together with the available literature, has led to the development of the idea that 6 more or less independent factors are involved in producing a smooth processed cheese. (1) The temperature and condition of heating; (2) the composition of the cheese; water, fat and casein-water ratio; (3) the degree of ripening or actual breakdown of the paracasein; (4) the proper pH zone, which, although influenced by the degree of ripening and salts present, should be within the limits 5.5 to 6.0, the zone of maximum peptization of the paracasein; (5) the presence of a salt which acts to reduce the calcium ion concentration or to remove calcium from the paracasein (phosphates, citrates, tartrates, carbonates); (6) The presence of a salt which acts as a paracasein peptizer. This effect my be aided or hindered by the salt added to control the calcium. One salt may be added to control the calcium and another quite different one may accomplish the peptization. The milk salts retained in the cheese, as well as the added sodium chloride influence the peptization.

SUMMARY

The pH precipitation zone of paracasein is much wider than that of casein.

Sodium fluoride, chloride and iodide increased the alkaline solubility zone of casein, but sodium iodide and chloride restricted the alkaline solubility zone of paracasein. Sodium fluoride showed an anomalous behavior with paracasein which is related to its plasticising action associated with the precipitation of calcium.

Paracasein in the presence of a suitable concentration of sodium chloride shows solubility zones at pH 2.5, 6.0, and 9.5, and zones of insolubility at pH 1.0, 4.5, and 7.0–9.0.

The texture of cheddar cheese is effected favorably by the peptizing action of sodium chloride on paracasein in the pH zone between 5.5 and 6.0.

The following factors influence the body and texture of processed cheese: (1) Conditions of heating; (2) Composition; (3) Degree of ripening; (4) pH zone; (5) Removal of calcium from paracasein; (6) Peptization of the paracasein.

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Bennett, F. W.
Bird, E. W.
Burgwald, L. J.
Burri, R.
Brueckner, H. J.
Burke, A. D.
Bushnell, L. D.

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Clevenger, W. L.
Cole, W. C.
Coulter, S. T.
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Dahlberg, A. C.
Darnell, A. L.
Demeter, K. J.
Doan, F. J.
Dorsey, L. M.
Downs, P. A.
England, C. W.
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Fabian, F. W.
Frayer, J. M.
Frazier, W. C.
Fuller, J. M.

Gelpi, A. J.
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Goss, E. F.
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Hansen, Arne
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Marquardt, J. C.
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Maynard, L. A.
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Nair, J. H.
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Overman, O. R.

Palmer, C. C.
Parfitt, E. H.
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Reid, W. H. E.
Richardson, G. A.
Riddell, W. H.

Sommer, H. H.
Stark, C. N.
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SPECIAL PUBLICATIONS

Federal Dairying and Bacteriological Establishment, Liebefeld, Berne, Switzerland

International Association of Ice Cream Manufacturers
International Association of Milk Dealers
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National Dairy Experiment Station, Hillerod, Denmark
National Institute for Research in Dairying, Reading, England

New York Association of Dairy and Milk Inspectors

Prussian Dairy Research Institute, Kiel, Germany

State Agricultural Colleges and Experiment Stations

The Royal Technical College, Copenhagen, Denmark

United States Department of Agriculture

ABSTRACTS OF LITERATURE ON MILK AND MILK PRODUCTS

BUTTER

The Diketone Produced when Butter Cultures Are Steam Distilled with Ferric Chloride Added. B. W. HAMMER, Iowa State College, Ames, Iowa. JOURNAL OF DAIRY SCIENCE *18*, 11, p. 769, Nov., 1935.

The data obtained indicate that the diketone steam distilled from butter cultures after the addition of ferric chloride is diacetyl rather than one of the homologues and that if homologues are present they are limited to relatively non-significant amounts.

B.W.H.

Substances Adsorbed on the Fat Globules in Cream and Their Relation to Churning. IV. Factors Influencing the Composition of the Adsorption "Membrane." CHARLES E. RIMPILA AND L. S. PALMER, Div. of Biochemistry, Univ. of Minnesota, St. Paul, Minnesota. JOURNAL DAIRY SCIENCE *18*, 12, p. 827, Dec., 1935.

A study was made of the percentage of protein and of phospholipids, the phosphatase activity and the Van Slyke nitrogen distribution of the protein in the adsorption "membrane" of different samples of natural cream after successive washings of the cream with distilled water and of the percentage of protein and phospholipids and the Van Slyke nitrogen distribution of the adsorption "membrane" of artificial creams obtained from washed emulsions of butterfat in skimmilk, buttermilk and sweet rennet-whey. The results show that the natural "membrane" is not derived from the components of milk plasma, but is a specific product having somewhat variable proportion of protein and phospholipids in different samples of natural cream but essentially the same proportion of major components in any one sample of cream after the fourth washing and at least through the tenth washing. A large part of the phosphatase activity of natural cream was found to reside in the "membrane" and was not removed by washing. The protein portion of all the "membranes" isolated from both natural and artificial creams was abnormally low in nitrogen, due apparently to a prosthetic group not yet identified.

L.S.P.

The Vitamin A Activity of Butter Produced by Cows Fed Alfalfa Hay and Soybean Hay Cut in Different Stages of Maturity. J. H. HILTON, S. M. HAUGE, AND J. W. WILBUR, Dept. of Dairy Husb., Pur-

due Univ., Agr. Exp. Sta., Lafayette, Indiana. JOURNAL DAIRY SCIENCE *18*, 12, p. 795, Dec., 1935.

In a study to determine the relative vitamin A values of alfalfa and soybean hay cut in different stages of maturity and cured by different processes, it was found that hays made from younger plants were higher in vitamin A values than hays made from older plants, and that the artificially dried hays were superior to the corresponding field cured hays. When these hays were fed to dairy cows as the chief source of vitamin A the butter produced by the cows fed the respective hays possessed a vitamin A potency similar in relationship to that possessed by the hays.

J.H.H.

The Vitamin Activity and Carotene Content of Butterfat from Ayrshire, Guernsey, Holstein and Jersey Cows. T. S. SUTTON AND W. E. KRAUSS, Ohio Agr. Exp. Sta., Wooster, Ohio. Ohio Agr. Exp. Sta. Bimo. Bul. *21*, 8, Jan.–Feb., 1936.

Samples of butterfat from comparable groups of Ayrshire, Guernsey, Holstein, and Jersey cows were prepared and assayed biologically for vitamin A potency. The Guernsey and Holstein fats were found to have approximately the same potency and both fats were significantly more potent than Ayrshire and Jersey fats. The potencies of the respective samples were not correlated with the carotene intakes per unit of fat produced.

Carotene determinations on the fats showed differences in the ability of the breeds to transfer feed carotene into milk carotene, as well as the effect of pasture feeding on carotene output. The carotene content of the milk fat of the breeds increased in the following order: Ayrshire, Holstein, Jersey, and Guernsey.

The lack of correlation between the carotene content of butterfat and the total vitamin A activity of such fat is thought to be due to inherent breed characteristics which regulate the degree of transformation of the food source of vitamin A (Carotene) into the colorless form in the process of milk fat formation.

Some discussion is devoted to speculation as to the vitamin A activity per quart of standardized and unstandardized market milk of the various breeds. It is pointed out, however, that any discrimination between breed milks on this basis alone is at the present time questionable.

W.E.K.

The Acidity of Butter. EUGENJUSZ PIJANOWSKI. Polish Agr. Forestal Ann. 34, p. 349 (p. 399 in English), 1935 .

In order to find a correlation between the acid test of butter and the acidity of its plasma, 36 samples of fresh creamery butter from different

plants were examined for acidity by taste and the acidity of butter plasma was determined by direct titration and from the following formula: $K_2 = \frac{100\,K - K_1 t}{100 - t} - 1.8$ where K = total acidity of butter, K_1 = acidity of butter fat and t fat content of butter. In addition, water, curd, casein, lactic acid (by aldehyde method) and pH value (electrometrically) were determined and stained microscopical preparations of all samples were made. The results are summarized: A fair correlation (r = 0.77) existed between the acid taste of butter and the acidity of its plasma as measured chemically. The acid taste of sour butter seemed to be closely connected with the acid smell of butter. A high correlation was found between the acid taste and percentage of lactic acid in butter (r = 0.72), between the total acidity of butter and the acidity of butter fat (r = 0.73) and between pH of plasma and percentage of lactic acid (r = 0.80). No correlation was found between the acid taste of butter and the acidity of butter fat. Diplococci, seldom streptococci, were found in stained preparations and the major part of butter was contaminated with yeasts and mold cells even though negative to the Storch test.

J.K.

Differences in the Lactic Acid Percentages in Butters. E. O. Whittier and C. S. Trimble, Bur. of Dairy Ind., U. S. Dept. of Agr., Washington, D. C. Ind. Eng. Chem., Anal Ed., *7*, p. 489, Nov., 1935.

The quantity of free or combined lactic acid in butter may serve as a suitable index to determine if the product has been made from sweet or sour cream.

Published analytical methods depending upon removal of protein and carbohydrates, are tedious in application, and are subject to errors of 3 to 15 per cent. The authors have developed a method which avoids any preliminary treatment of the butter. Ten, twenty or thirty g. (depending on the percentage of lactic acid present) are weighed directly into a 300 c.c. Kjeldahl flask and the lactic acid and lactates are oxidized to acetaldehyde by the technique of Friedemann, Cotonio and Shaffer (J. Biol. Chem., 73, 335, 1927). The aldehyde is absorbed in sodium bisulfite solution with which it forms a compound. The excess of bisulfite is oxidized with standard 0.1 N iodine solution, after which the bound sulfite is liberated with alkali and titrated with 0.01 N iodine solution. A determination can be made in approximately twenty minutes with an accuracy of 97 per cent or greater.

After preliminary determinations on sixteen commercial samples of butter, the authors prepared forty samples of butter from two lots of cream, each lot being subdivided and given various treatments before and after churning. Each sample was analyzed for apparent lactic acid by the method described. Results ranged between 0.013 and 0.262 per cent. Twenty commercial samples of butter, four of which were churned from sweet cream,

were obtained from Southern creameries and analyzed. The sweet cream butters showed consistently less than 0.025 per cent of apparent lactic acid; the partially neutralized samples, consistently more than 0.05 per cent. Examination of sweet-cream butter before and after storage demonstrated that lactic acid does not develop in appreciable quantities even during long storage periods.

The authors conclude that butter made from normal sweet cream containing less than 0.25 per cent of titratable acid will contain less than 0.025 per cent of apparent lactic acid, while that made from normal sour cream containing more than 0.40 per cent acid will contain more than 0.100 per cent of apparent lactic acid. If sour cream be neutralized to approximately 0.20 per cent acidity, butter made from it will contain more than 0.05 per cent of apparent lactic acid.

J.H.N.

Keeping Cream Cool in the Cream Station. E. L. Fouts, Oklahoma A. and M. College, Stillwater, Oklahoma. Nat. Butter and Cheese J. *26,* 14, p. 14, July 25, 1935.

The Dairy Department of Oklahoma A. and M. College has found that an inexpensive way to cool cream for buttermaking is to stack the burlap wrapped cream cans into piles two cans high and keep a very fine spray of water, just enough to keep the burlap damp, directed over the cans. Evaporation of the water holds the cream at around 75° F. The highest cost is about one cent per 10 cans for a 24 hour period.

W.V.P.

XVII. A Study of Seasonal Variation in Butterfat. II. A Seasonal Spectroscopic Variation in the Fatty Acid Fraction. Roland Booth, Stanislaw K. Kon, William Dann, and Thomas Moore, Nutrition Lab., Univ. of Cambridge, England, and National Inst. for Research, Univ. of Reading, England. Biochem. J. *29,* 133, 1935.

Seasonal variations in the carotin and vitamin A contents of butterfat are well known. A method for determining the vitamin A value of butterfat involves the use of antimony trichloride. It is also known that there is a seasonal variation in the power of butterfat to inhibit the reaction between vitamin A and antimony chloride. Examination of 15 samples of butter covering 13 months shows a variation in the intensity of absorption at 230 mμ ranging from (April, 1933) $E\frac{1 \text{ per cent}}{1 \text{ c.m.}} = 8.4$ to (May, 1934) $E\frac{1 \text{ per cent}}{1 \text{ c.m.}} = 250$ when cows had access to pasture. The increase in absorption runs approximately parallel with the increased inhibitory power of the butterfat in the antimony trichloride reaction for vitamin A. However, the sub-

stances responsible for the inhibitory power are more sensitive to oxidation and irradiation than those responsible for 230 mμ absorption. Other factors, such as unrecognized acids or modified forms of known unsaturated acids with high extinction coefficient may be responsible for the increased absorption of summer butterfat.

K.G.W.

Contribution to the Study of Diacetyl. JEAN PIEN, JACQUES BAISSE AND ROBERT MARTIN. Le Lait *16*, p. 119 and p. 243, 1936.

The most satisfactory method of preparing diacetyl was found to be the treatment of ethyl methyl ketone with amyl nutrite to yield the nitroso derivative. By the action of dilute soda on this substance, isonitrosoethyl methyl ketone was formed. The isonitrosoethyl methyl ketone was then freed from contaminating substances, isolated, and water and dilute sulphuric acid added to it. Diacetyl was finally obtained by steam distillation from this mixture. The diacetyl separates in an upper layer in the steam distillate. By redistillation over calcium chloride practically pure diacetyl can be obtained.

The use of hydroxyl amine and nickel salts in determining diacetyl as the nickel dimethylglyosimate was considered a satisfactory qualitative test but was considered inaccurate for the quantitative estimation of diacetyl. Another qualitative test for diacetyl was found in the condensation of two molecules of diacetyl to yield the cylic compound, xyloquinone. On adding a pellet of caustic potash to the diacetyl solution a yellowish brown color of the xyloquinone appeared. The appearance of this color on adding caustic potash is not a specific test for diacetyl but as tests for diacetyl are usually made on distillates and relatively purified solutions the use of this very rapid method serves as a convenient test—at least as a test for the absence or possible presence of diacetyl. Diacetyl may also be determined qualitatively and characterized by its reaction with phenyl-hydrazine. In the cold, diacetyl reacts readily with phenyl-hydrazine to yield diacetylphenylhydrazone. The crystals of this compound exist in the shape of crosses of St. Andrew and serve better to identify diacetyl than do the crystals of diacetylphenylosazone which are obtained when diacetyl is heated on the water bath with an excess of phenylhydrazine. The most acceptable procedure for the quantitative determination of diacetyl was based on the reaction of diacetyl with compounds of the orthodiamino benzine type. Actually it was found more convenient to use meta-para-toluylene-diamine instead of diamino benzine. The diamine used was prepared by treating para-toluidine with acetic anhydride (the acetylation, of course, being for the purpose of protecting the first amino group while the second was being introduced). The acetylated toluidine was then treated with nitric acid which allowed introduction of the NO_2 group. On heating with caustic potash the original

amino group was restored and on reducing with hydrochloric acid in the presence of granular tin, the NO_2 group was reduced and the diamino compound is formed. This reagent is used for determining diacetyl in the following manner:

About 10 cc. of the solution to be tested is placed in a test tube and 5 cc. of an aqueous solution of 1 per cent metaparatoluylenediamine is added. After shaking, 10 cc. of concentrated sulphuric acid is carefully added, placing the pipette against the wall of the tube. There then develops the yellow color of the quinoxaline compound. The maximum color develops after the solution has stood for about one hour.

One part per 100,000 of diacetyl can be detected by this test but the test is best carried out on solutions containing diacetyl in amounts ranging between 1 to 5,000 and 1 to 10,000. Permanent standards for determining diacetyl may be prepared with potassium bichromate dissolved in water. The quantitative procedure which has been described was applied to the determination of diacetyl in a number of dairy products such as milk, cultured milks, butter, cream, etc. It was found that the quantity of diacetyl contained in these products was very low. Thus butter never contained more than 5 milligrams of diacetyl per kilo. The usual lactic starters contained as a rule less than 1 milligram of diacetyl per liter. Cream even when held for several weeks did not contain more than 1.5 milligrams per liter. Some butters, milks and creams contained no diacetyl at all. However, the authors believe that in spite of these low values for diacetyl that diacetyl may be important in contributing to the flavor and aroma of butter because only small amounts of diacetyl are required to produce a very noticeable aroma and because of the much higher acetyl methyl carbinol content of dairy products which therefore may serve as a continual reservoir to supply diacetyl. The possibility that methyl gyloxal may contribute to the flavor and odor of dairy products is also suggested. The authors are in accord with the French law of July, 1935, which prohibits the addition of diacetyl to dairy products. However, they believe that research should be continued on the substance to the end of gaining a better understanding of the part it plays in fermentation and in contributing to the aroma of dairy products.

A.H.J.

Bacteriological Analysis of Butter from the Region of Brest. Biology of the Typhoid Bacillus in Butter. J. Brisou, Doctor of Science of the University of Bordeaux. Le Lait *15*, p. 864, 1935.

About 5 grams of butter are first emulsified in 15 cc. of sterile bile. Five cc. of the bile-butter emulsion are then added to a flask containing 50 cc. of physiological salt solution, 50 cc. of 6 per cent peptone solution, and 2 cc. of malachite green (1 to 200). The flask and contents are then incubated at 37° C. for 24 to 36 hours (or a shorter period if the medium decolorizes too

rapidly). After incubation, the material is inoculated on freshly prepared lead acetate- agar plates. After growth on this media the colonies are identified in the usual way. The vitality of the organisms in butter was studied and considered to be related to the pH and not the free acidity. At pH values below 6, the vitality was reduced.

A.H.J.

Butter Improvers Based on Diacetyl—Are They Natural Products? M. LEMOIGNE AND P. MONGUILLON. Le Lait *16*, p. 26, 1936.

Just as with 2, 3 butyleneglycol and with acetylmethylcarbinol, diacetyl is a normal product of the metabolism of living organisms but the latter is found only in traces in biological fluids or bacterial cultures. Actually the presence of 1.5 to 2 grams of diacetyl per liter inhibited or destroyed the group of bacteria on which it was tested. It therefore appears that the group of butter improvers on the market containing 5 to 7 grams of diacetyl per liter cannot be considered as natural products.

A.H.J.

Chemical Study of Butter. R. VIVARIO AND G. VAN BENEDEN. Le Lait *16*, p. 113, 1936.

Butters were characterized by their contents of four groups of fatty acids which have been classified as follows: the acids of low molecular weight such as butyric and caproic, the acids of average molecular weight (caprylic, capric, lauric, and myristic), unsaturated fatty acids (oleic), and the acids of high molecular weight (palmitic and stearic). Rapid methods of determining and calculating the four groups of fatty acids are given. Results obtained on three butters show that when the content of acids of average molecular weight was high, the content of acids of high molecular weight was low. Moreover the sum of these two groups of acids varied inversely with the oleic acid content. The content of acids of low molecular weight varied in the same way as the oleic acid content.

A.H.J.

Methods of Cooling and Storing Cream for Oregon's Dairy Farms: Influence on the Quality of Butter which Can be Manufactured. G. H. WILSTER, H. HOFFMAN, AND P. M. BRANDT, Dairy Dept., Oregon Agr. Exp. Sta., Corvallis, Oregon. Oregon Agr. Exp. Sta. Bul. 326, June, 1934.

This study was undertaken to determine the conditions under which cream could be kept on farms in order that 92-score butter could be made from it at the creameries.

Of the various methods studied, that of placing a five gallon can of cream with an initial temperature of 90° F. in a tank of flowing water having a temperature ranging from 47° to 54° F. was the most satisfactory for maintaining the quality of the cream. The score of butter made from such cream stored for 72 hours scored two points higher than that made from cream cooled by and stored in air at 44° to 86° F. with the mean daily temperature ranged from 53° to 77° F. It also averaged one point higher than the score of butter made from cream cooled and stored in a tank of still water which was changed twice daily and which had an initial temperature of from 47° to 60° F. Quick cooling of cream with water with an initial temperature of 47° to 60° F. followed by storing at air temperature, maintained the flavor better than cooling and storing at air temperature. Precooling in the above manner followed by storage in either still or running water was of no additional benefit.

The scores of butter that could be made from cream cooled and stored in different ways are given in the bulletin.

G.H.W.

How Can I Increase My Profits and Pay More for Butterfat? (No author given.) Nat. Butter and Cheese J. *26*, 14, p. 20, July 25, 1935.

A discussion dealing with increasing dairy plant profits by purchasing cream on a grade basis, increasing the quality of the product, improving production efficiency and direct marketing. W.V.P.

CHEESE

Bel-Paese Type Cheese. Fred Kopp and George F. Jackson, Univ. of Calif., Davis, Calif. The Pacific Dairy Rev. *39*, 5, p. 14, May, 1935.

For approximately fifteen years the firm of Galbani Brothers of Melzo, Italy, has placed upon the market a cheese under the trade name of Bel-Paese. This cheese has gained great popularity not only in Italy but in southern and central Europe as well. It was observed that the Italian population of California demanded the cheese and it was believed that a similar cheese could be made in that state. The first mentioned author had the opportunity to observe the manufacturing and curing process of this cheese in Italy, and was able to produce a cheese which compared favorable to the imported product. The method of manufacturing and curing consisted of setting the highest quality of whole cow's milk obtainable at a temperature of 106 to 110° F. with rennet extract so that it would set in approximately fifteen minutes. The use of cone-shaped cans of 400 to 600 pound capacity was common practice.

When fairly firm the curd is cut crosswise with a long knife and reduced to the size of hazel nuts by the use of the scoop. At this point the curd is

gently put in a vertical revolving motion by means of an agitator. This is continued from six to eight minutes, after which the whey is drawn off the level of the settled curd. The curd is dipped into perforated metal hoops 7¾ inches in diameter by 7½ inches high which rested upon reed mats.

A temperature of 80 to 86° F. is maintained for a period of 5½ to 7 hours while the cheese is draining. To obtain satisfactory rind the cheese should be turned at least three times while draining. The hoops are removed and cheese placed in 17 per cent salt brine solution at 60° F. for a period of 6 to 10 hours. The cheese are placed on shelves in the curing room at 45° F. with relative humidity of from 88 to 92 per cent for 6 weeks with good circulation of air in room. Early in the curing period the surfaces of the cheese are colored a light yellow color and are washed and turned every other day.

The cheeses are wrapped either in waxed paper or aluminum foil and packed individually in wooden boxes. Packed in this manner they may be stored for four weeks at low temperature. The cheese produced compared favorably in chemical composition as well as in flavor and texture with the imported cheese. P.A.D.

Moldiness in Romano Cheese. F. W. Fabian and J. W. Severns, Dept. of Bact. and Hygiene, Mich. State College, East Lansing, Michigan. Journal Dairy Science *18*, 11, p. 773, 1935.

A factory manufacturing Cacio Pecorino cheese, more commonly known as Romano cheese, from cows' milk reported that they were having considerable trouble with mold developing in the center of many of the cheeses. Upon investigation, it was found that it was the practice at this factory to punch the cheeses full of holes to facilitate the penetration of the 30 salometer brine in which they were soaked for about 3 days prior to ripening. This permitted the entrance and growth of molds. The mold isolated and identified from the samples of cheese submitted was *Pencillium italicum*. Chemical determinations for NaCl and moisture in different portions of the cheese indicated that the moisture content of the cheese would have to be approximately 25 per cent and the salt content not greater than 6 per cent to permit mold growth to take place. F.W.F.

Future of the Industry Depends on Satisfying the Consumer. C. R. Barker. Nat. Butter and Cheese J. *26*, 14, p. 26, July 25, 1935.

The most important consideration in the production of cheese is to please the ultimate consumer with quality, price and service. This can best be done by making better cheese, by a system of critical grading and by standardizing quality to suit the market. W.V.P.

Studies on the Manufacture of Trappist Type Cheese. J. C. Marquardt, N. Y. Agr. Exp. Station, Geneva, N. Y. N. Y. Agr. Exp. Sta. Bul. No. 662, Jan., 1936.

In this publication the author gives a brief review of the history of semi-hard cheeses of this type. The publication includes methods for making the natural and blended cheeses. There is also included a table of analyses of cheeses of this type taken from the work of the author and others.

The author concludes that a saturated humidity and a curing room temperance of 60° F. or below are essential to properly cure the cheese. Moistures from 40–45 per cent and salts ranging in percentage from 1.0 to 2.5 produced good cheeses.

Trappist cheese can be made by several methods that vary in detail but fundamentally not in principle.

Fading flavor, gritty cheese, and bitter flavor are common defects of cheeses of the Trappist type. J.C.M.

Sweet-Curd Cottage Cheese (Directions for Manufacturing with an Enzyme). P. H. TRACY AND H. A. RUEHE, Univ. of Ill., Urbana, Illinois. Ill. Agr. Exp. Sta. Cir. 445, Jan., 1936.

Factors relating to the quality of sweet-curd cottage cheese are listed and discussed. The methods for making sweet-curd cottage cheese, (1) a sixteen-hour and (2) a five-hour method, are described and causes of common body defects are given. O.R.O.

Cottage Cheese. JULIA NORWOOD, Modern Science Institute, Toledo, Ohio. The Milk Dealer *25*, 6, p. 38, March, 1936.

The author discusses the origin of the name and the food value of cottage cheese. Several recipes are given for using cottage cheese. C.J.B.

Experiments Relating to the Manufacture of "Port-Salut" Using Pasteurized Milk Inoculated with Lactic Organisms. CH. PORCHER AND G. THIEULIN. Le Lait *15*, p. 19, 1935.

Pasteurization of milk for cheese making has not only the advantage of destroying undesirable organisms but also the disadvantage of destroying desirable acid-producing organisms. The use of lactic organisms is discussed in relation to the production of the desired acid content for proper curdling of the casein. Preliminary experiments are described using carbon dioxide, carbon dioxide plus calcium chloride, and calcium chloride as aids in producing the proper type of curd and the desired consistency in the finished cheese. A.H.J.

Vegetable Rennin. Extraction and Properties. C. CHRISTEN AND E. VIRASORO. Le Lait *15*, p. 354, p. 496, 1935.

A plant enzyme having a strong coagulating effect on milk was prepared from thistle flowers. One hundred grams of the dry flowers were extracted

with petroleum ether and then washed on a filter paper with ether. After evaporation of the ether, the material was ground to a powder and the powder extracted with 500 cc of 20 per cent ethyl alcohol. Filtration under vacuo yielded a clear, caramel-colored liquid of pH 4.7–4.8 which had a coagulating activity of 1:800. This preparation was stable for about 40 days when it became cloudy and molds began to develop. On evaporating the fresh extract to dryness a water-soluble caramel-colored residue equivalent to 6 per cent of the extract was obtained. The residue had an activity of 1:13,000. On increasing the alcohol content of the extract to 75 per cent, a precipitate of activity 1:36,000 was obtained. The total precipitate, however, had a coagulating power equivalent to only about one-fifth of that of the total extract from which it was prepared. The optimum temperature for the activity of this vegetable rennin was 68 per cent. Freezing the enzyme preparation operated to increase slightly the activity of the enzyme. Exposure to sunlight or to ultra-violet light had no effect on the activity of this plant rennin but such exposure reduced considerably the activity of animal rennin. This enzyme was used in making Camembert cheese and it was suggested that it might replace animal rennin without disadvantage in the making of most types of cheese. A.H.J.

The Pasteurization of Milk Intended for the Manufacture of Cheese. JEAN PIEN. Le Lait *15*, p. 748, 1935.

The compulsory pasteurization of milk to be used for cheese making is not to be recommended at the present time because of the difficulties experienced in inducing the proper curdling of pasteurized milk, definite types of curdling being necessary in producing certain types of cheese. A.H.J.

The Bacteriology of Swiss Cheese. IV. Effect of Temperature upon Bacterial Activity and Drainage in the Press. L. A. BURKEY, G. P. SANDERS, AND K. J. MATHESON, Bureau of Dairy Ind., U. S. Dept. of Agr., Washington, D. C. JOURNAL DAIRY SCIENCE *18*, 11, p. 719, 1935.

Temperature, pH, and bacterial counts made at regular intervals and at definite distances from the hoop edge toward the center of 55-pound laboratory and large factory cheeses show that cooling occurs rapidly in the outer 1-inch area, becoming less rapid toward the center, the interior reaching 36° to 46° C. in 21 hours, depending on the size of cheese and the room temperature; that bacterial growth and acid production increases in general with the decrease in temperature of each part of the cheese; and that while most starter bacteria begin to increase in numbers near the outer edge during the first few hours, the initiation of growth in the interior occurs with *S. thermophilus* (C_3) within 2 or 3 hours, while *L. bulgaricus* (Ga and 39aH) after 5 or 6 hours, and with *L. helveticus* (39a) not until 9 or 10 hours after dipping. Large differences in pH between the interior and the area near the rind

result in insufficient drainage, and may cause such defects as checking near the rind and "glass." A sample of cheese for analysis in order to be representative of the interior should be obtained at least 4 inches from the hoop edge. The proper use of starters, especially an active *S. thermophilus*, facilitates early expression of whey from the interior and aids in the uniform drainage of the cheese. L.A.B.

Camosum Cheese. N. S. GOLDING, State College of Washington, Pullman, Wash. Wash. Exp. Sta. Bul. 175 (Reprint), 1934.

The author fully describes a process for making a cheese for local marketing or home use, which is simple to make, requires a minimum of time, and inexpensive utensils. The process is based on the stirred curd principle, uses brine salting, and the cheese requires from one to three months to ripen. N.S.G.

CONCENTRATED AND DRY MILKS

The Age Thickening of Sweetened Condensed Milk. V. C. STERNITZ AND H. H. SOMMER, Dept. of Dairy Industry, Univ. of Wisconsin, Madison, Wis. JOURNAL DAIRY SCIENCE *18*, 11, p. 757, 1935.

The period of the year during which there is a tendency for sweetened condensed milk to thicken abnormally fast during storage was found to begin very abruptly and to occur any time from the middle of April to the middle of May in the territory of Madison, Wisconsin. The change back from unstable to stable milk occurred more slowly and took place during the latter part of June and July. This unstable period could not be correlated directly with the freshening of the cows or the time at which they were turned out on grass. The experimental vacuum pan for condensing the milk and the vacuum tube arrangement for measuring the viscosity of the condensed milk by the falling sphere method are described. V.C.S.

The Age Thickening of Sweetened Condensed Milk. II. The Effect of Forewarming Conditions. V. C. STEBNITZ AND H. H. SOMMER, Dept. of Dairy Industry, Univ. of Wisconsin, Madison, Wisconsin. JOURNAL DAIRY SCIENCE *18*, 12, p. 804, 1935.

Forewarming conditions exert a marked influence on the subsequent age thickening of sweetened condensed milk. Forewarming temperatures of 150 and 165° F. make a product which thickens less rapidly than heating the milk to only 135° F. With temperatures from 180° F. up to boiling the milk becomes considerably more unstable, while temperatures above boiling again make the milk less susceptible to age thickening.

Prolonged holding periods at the forewarming temperature tend to unstabilize stable milk, but have a slight effect in stabilizing unstable milk.

Having the sucrose in contact with the milk during forewarming has the greatest effect in causing the milk to thicken during storage, while having the sucrose in contact with the milk only during condensing at a temperature of 131° F. greatly decreases the viscosity, but makes a more viscous product than adding the sucrose as a syrup near the end of the condensing period.

Excessive age thickening may be prevented by withholding the sucrose during the time that the milk is at forewarming temperature. V.C.S.

The Age Thickening of Sweetened Condensed Milk. III. Effect of Reaction and Changes in the Electrical Conductivity during Manufacture and Aging. V. C. STEBNITZ AND H. H. SOMMER, Dept. of Dairy Ind., Univ. of Wisconsin, Madison. JOURNAL DAIRY SCIENCE *19*, 1, 55, Jan., 1936.

The addition of two to four ounces of sodium bicarbonate to 1000 pounds of the raw milk before concentration materially reduced the thickening of condensed milk during aging. A.C.D.

Irradiated Evaporated Milk: The Transmission and Antirachitic Activation of Evaporated Milk Films by Ultra-violet Radiations. G. C. SUPPLEE, R. C. BENDER, G. E. FLANIGAN, M. J. DORCAS, AND C. E. GREIDER, The Dry Milk Co., Rsh. Lab., Bainbridge, N. Y., and National Carbon Co., Inc., Cleveland, Ohio. JOURNAL DAIRY SCIENCE *19*, 1, p. 67, 1936.

Films of evaporated milk tend to be more dense than films of milk so that the influence of irradiation is less in increasing the vitamin D potency. A.C.D.

The Effect of Process of Manufacture on the Vitamin G Content of Dried Skimmilk. H. J. DAVIS AND L. C. NORRIS, Cornell Univ., Ithaca, N. Y. JOURNAL DAIRY SCIENCE *19*, 1, p. 1, Jan., 1936.

There was no significant destruction of the growth-promoting component of the vitamin G complex in skimmilk when dried by the spray or open-roll process. A.C.D.

Determination of Lactose in Mixed Feed. D. A. MAGRAW AND C. W. SIEVERT, American Dry Milk Institute, Chicago, Ill. Ind. Eng. Chem., Anal. Ed., *7*, p. 106, March, 1935.

A method for the quantitative determination of lactose in mixed feed has been developed and shown to be accurate to ± 0.25 per cent Reducing sugars which are not fermentable by ordinary yeast are usually present and must be changed by enzymes to a fermentable form without an accompanying change in the lactose present.

16.25 g. of the feed are extracted with 100 cc. of ethyl ether to remove fat. The residue is digested with water on a water bath for 30 min. and made up to a volume of 300 cc. After centrifugalizing, 150 cc. of the clear solution is transferred to a 200 cc. flask, 100 mg. of animal diastase, 75 mgm. of invertase-melibiase scales, and 1.5–2 g. of baker's yeast are added and fermentation carried out for 40–48 hours at 24.4° to 26.7° C. (76°–80°F.). The solution is made up to volume and centrifugalized, 190 cc. of the same then concentrated to 25–30 cc. by boiling, transferred to a 100 cc. flask with the aid of hot distilled water, treated with 10 cc. of saturated neutral lead acetate and completed to volume. After another centrifugal clarification 50 cc. of the clear solution is placed in a 100 cc. flask, treated with 2.5 cc. of a 5 per cent solution of mercuric chloride, let stand for 20–30 minutes with repeated shakings, 5 cc. of a 20 per cent phosphotungstic acid solution added, distilled water added to complete the volume, and the liquid again centrifugalized.

If not clear, the solution must be filtered through a dry paper, after which it is saturated with hydrogen sulfide and the precipitate filtered off. Fifty cc. of the clear solution are pipetted into a 300 cc. Erlenmeyer flask and boiled to get rid of the hydrogen sulfide. This solution is brought up to a volume of 50 cc. in a volumetric flask and lactose determined by the Munson and Walker method. Jena fritted-glass filtering crucibles I. G. 4 are recommended for collecting the copper oxide. The weight of reduced copper should be checked by solution of the oxide with 5 cc. of 1 to 1 nitric acid, followed by the application of the volumetric sodium thiosulfate method for copper. The corresponding weight of lactose is obtained from the Munson and Walker table.

The following formula is used to calculate the weight of dry material in the aliquot taken:

$$\frac{150}{(300-8)} \times \frac{190}{200} \times \frac{\mathbf{50}}{100} \times \frac{5}{(100-1)} \times 16.25 = 2.003 \text{ g.}$$

To obtain the percentage of lactose in the feed, the following formula is applied:

$\frac{(X - 0.005)}{0.90 \times 2} \times 100$ where X = grams of lactose found, 0.005 is blank correction, 0.90 is the lactose factor for fermentation loss, and 2 is the weight of dry material taken (0.003 dropped as well within the experimental limit).

The percentage of lactose multiplied by 2 gives the percentage of dry skimmilk in the feed mixture. If dried buttermilk is the dairy product used, then the percentage of lactose must be multiplied by 2.775 to obtain the percentage of dried buttermilk. Such calculations are possible only when the exact type of dairy product used in the feed is known.

Determinations of lactose in a number of samples of feeds known to contain dry skimmilk are given and indicate that the method is reliable and

accurate to 0.25 per cent of lactose. While tedious, the technique is simple, with the temperature of fermentation the only condition demanding close control. The presence of molasses in the feed causes an error due to non-fermentable "glutose." Five per cent of molasses causes an increase of 0.2 per cent in the amount of lactose found in the sample. J.H.N.

Raising Dairy Calves with Dried Skimmilk. J. C. KNOTT, R. E. HODGSON, AND E. V. ELLINGTON, Washington State College, Pullman, Washington. Agr. Exp. Sta. Bul. 273, 1932.

The authors conducted experiments to determine if dairy calves could be raised on hay, water and a dry calf meal containing dried skimmilk, when no other milk was fed after six weeks of age. The calves were fed two weeks on whole milk; from the second to the third week they were changed to remade skimmilk, and from the fifth to the sixth week they were changed to no further liquid milk. The calves raised by this system were thrifty and vigorous at six months of age, and in no way distinguishable from heifers raised in the usual way on separated skimmilk.

The authors conclude that the system of raising dairy heifers as used in this experiment can be successfully used by dairymen where liquid skimmilk is not available.

In areas where whole milk is sold, this system materially reduces the cost of raising calves.

Feeding the dried skimmilk in the grain mixture reduces the labor required for feeding calves.

The economics of feeding dried skimmilk is fully discussed. At a value of 5 cents per pound for dried skimmilk the average cost of feeding a Holstein heifer was $20.02 to six months of age; during which time an average of 151.5 pounds of dried skimmilk was fed each calf. N.S.G.

Practical Apparatus for Determining the Fatty Material in Rennet Casein. J. DELORME. Le Lait *15*, p. 36, 1935.

To 10 grams of pulverized casein are added 20 cc. of concentrated hydrochloric acid. These materials are slowly heated to slight boiling until the casein dissolves. Gentle boiling is continued for 20 minutes in order to liberate the fat. After cooling, 50 cc. of water are added and the fatty material is extracted by shaking with 55 cc. of ethyl ether. An ether layer forms after standing for two hours. This ether layer is drawn off, the ether evaporated and the fatty matter weighed. An extraction apparatus is shown in which the dissolving of the casein and the extraction of the fat is conducted.

A.H.J.

Remarks on an Apparatus for Determining the Fatty Material in Rennet Casein. MARC FOUASSIER. Le Lait *15*, p. 386, 1935.

Fouassier comments on the above method and refers to work of his own on a similar method. It is suggested that separation of ether and aqueous layers be expedited by concentration. A.H.J.

The Corrosion Metals in the Course of the Manufacture of Condensed Milk. G. GENIN. Le Lait *15*, p. 159, 1935.

A review of recent work is given. It is concluded that on the basis of corrosion practically all metals constitute a better material for the construction of evaporators for milk products than does copper. A phenomenon which automatically operates to check the corrosion of metals in contact with the milk products being processed is the formation of a protective milk film. This protective film is less effective in the case of copper. A.H.J.

Improvements in the Manufacturing Process of Casein. G. GENIN. Le Lait *15*, p. 251, 1935.

Casein manufactured by former processes was of irregular quality due to difficulties in (1) precipitating at the right hydrogen ion concentration, (2) in removing milk salts and lactose and (3) in removing the acid used for precipitating the casein. The present method yields an improved product by solving these difficulties. Hydrochloric acid of specific gravity 1.2 which has been diluted to 1 to 4 with water is used as the precipitating agent. The milk is heated to 44° C. before addition of the acid. Immediate mixture of the milk and acid in a uniform manner allows rapid separation of the curd from the serum. The use of hydrochloric acid yields soluble salts with the inorganic constituents of casein. Effective washing allows the ready removal of these salts and other soluble milk constituents. Pressing the curd between special rollers prevents the formation of large aggregates of casein. Rapid drying of the small casein particles prevents the formation of protective skins under which hydrolysis may proceed. A.H.J.

The Manufacture of Milk Sugar. G. GENIN. Le Lait *15*, p. 627, 1935.

After removing the casein from skimmilk, the serum is neutralized with calcium or barium carbonate and then heated in a special autoclave to cause coagulation of the albumin. The coagulated protein is removed by filtration, siphoning, or decantation and the filtrate concentrated under vacuo to a 60 per cent solids content. The concentrated filtrate then goes to the crystallizers where a crude lactose containing 10 to 15 per cent of impurities (salts and albumin) is obtained. The crude lactose is dissolved and decolorizing carbon added. Acetic acid to precipitate the protein and magnesium sulphate to remove the phosphoric acid are then added and the solution heated to 90° C. after which the solution is filtered through a filter press and again concentrated under vacuo to a solids content of 60 per cent. After allowing the

concentrated solution to stand for several days, the lactose crystallizes and is removed by centrifugation. In order to obtain a white powdered lactose a further refining is necessary. The partially refined lactose is dissolved to give a solution of 15° Baumé and a small amount of aluminum sulfate or calcium chloride is added. The solution is then passed through the filter press and concentrated to a Baumé of 22°. The refined lactose crystallizes from this solution and is separated by centrifugation. Uses of lactose are also discussed. A.H.J.

The Production of Artificial Wool in Italy and Its Repercussions on the Dairy Industry. GEORGE RAY, Chief of the Intern. Institute of Agr. of Rome. Le Lait *16*, p. 148, 1936.

In the making of artificial wool either dry casein or washed casein curd may be used. The casein is first dissolved in an alkali or alkaline salt solution and the solution then matured and passed through a draw plate in order to obtain the filaments. The filaments pass into an appropriate bath where they are rendered solid. After removal from the bath the threads are dried. The threads thus obtained closely resemble woolen strands in tenacity, insulating value, hygroscopicity and drying properties. A given weight of casein yields about the same weight of the artificial wool. In order to yield sufficient casein to replace wool, a considerable increase in cow population would be necessary with consequent increase in the supply of butter. It is suggested that the whey remaining after the casein has been precipitated from the skimmilk be worked up as feed for swine. A.H.J.

ICE CREAM

Trucking Problems and Costs. A Preliminary Report on the Trucking Survey. O'NEAL M. JOHNSON, Intern. Assoc. of Ice Cream Mfgrs., Washington, D. C. Proc. 35th Ann. Conv. Intern. Assoc. of Ice Cream Mfgrs. *3*, p. 39, Oct., 1935.

The survey included the following types of trucks which were reported. The percentage of the total represented by each type is given.

Trucks by Type Refrigeration

Solid carbon dioxide	24.15 per cent
Mechanical or electrical unit	11.39 per cent
Cartridge	36.73 per cent
Open body, no refrigeration	3.41 per cent
Ice and salt	23.98 per cent
Miscellaneous	.34 per cent

The useful life of trucks, total mileage, and total operating cost per mile were found in this survey to be as follows:

Type of Truck	*Useful Life in Years*	*Miles*	*Total Cost Per Mile*
Ice and salt, less than 2.5 tons	4	84,000	$.1685
Ice and salt, 2.5 tons or more	5	91,000	.2830
Other than ice and salt, less than 2.5 tons	5	95,600	.1370
Other than ice and salt, 2.5 tons or more	6	120,000	.1990

Ninety-five per cent of those answering considered it cheaper to own and operate trucks for routes in excess of 75 miles rather than to hire trucks. Seven per cent of those answering use electric trucks and only 2 per cent use horses and wagons. M.J.M.

The Cost of Manufacture and Distribution of Different Products. L. C. ANDERSON, General Ice Cream Corp., Schenectady, N. Y. Proc. 35th Ann. Conv. Intern. Assoc. of Ice Cream Mfgrs. *3*, p. 29, Oct., 1935.

In the past costs were determined on the basis of gallonage. This practice was satisfactory because only one test of ice cream was made and novelties amounted to very little. The ice cream business today is vastly different; bulk ice creams of different compositions are sold and novelties frequently represent as much as 25 per cent of the sales. A good cost system must follow through the manufacturing process for each individual product.

Material costs can be computed easily for each product. Mix making costs differ because some products are made without homogenization while others are heated and homogenized. Freezing costs vary because ice cream is frozen in the ice cream freezers while some products are frozen without agitation. The cost of different packages of ice cream differ in the way they are handled from the freezer to the hardening room. Other costs which must be distributed to the different products are power, light, heat, refrigeration, depreciation and repairs, delivery, selling, and general administrative expenses.

Reasonably reliable costs for each individual product handled are necessary in order to determine sales prices and policies with respect to handling the various items sold. M.J.M.

The Cost of Serving Small Dealers. E. W. CREDICOTT, Freeport Dairy and Produce Co., Freeport, Ill. Proc. 35th Ann. Conv. Intern. Assoc. of Ice Cream Mfgrs. *3*, p. 22, Oct., 1935.

In studying the problem of the small account it was found that the cost varies considerably. Two accounts of the same volume may have different costs. When two things are being sold—ice cream and service (distribu-

tion); the cost of the service is the variable. Under service costs four divisions should be studied; cabinet depreciation, cabinet maintenance, selling cost and delivery and trucking cost.

Cabinet depreciation was charged to each account only for the months during which the cabinet was used. Cabinet maintenance was charged on a "per machine" basis. For the first seven months of 1935 the cost per machine varied from $1.91 to $2.91 a month. The selling and advertising cost was charged on an account basis and for 1935 varied from $3.02 to $6.31 a month per account. Charging delivery on a gallon basis proved inaccurate as did charging on an account basis. The per gallon weighted average for a 300-gallon account for the year was $53.09 while the average per account was $73.19. Delivery costs vary widely for an account located on an existing skeleton route as compared with another off the regular route.

No fixed rules for determining costs can be given. The above general divisions of costs should be made and intelligently applied to each account. Such factors must be taken into consideration for each account as (1) gallonage, (2) whether or not the distributor owns the cabinet and other equipment, and (3) whether or not the account is on a trucking route. M.J.M.

The Solubility-freezing Point Relationships of Water Solutions Saturated with Respect to Sucrose and Dextrose in Relation to the Storage of Sherbet and Water Ice. ALAN LEIGHTON AND ABRAHAM LEVITON, Bur. of Dairy Ind., U. S. Dept. of Agr., Washington, D. C. JOURNAL DAIRY SCIENCE *18*, 12, p. 801, 1935.

Although it is known that crusting or surface hardening of sherbets and ices is due to sugar crystallization and that this crystallization may be postponed or prevented by use of definite proportions of dextrose, exact experimental data on solubilities and freezing points of this mixture are not available.

It was found in this study that the eutectic point, the lowest temperature attainable without supersaturation with the sugars, –17.9° C. (0° F.). At this temperature the mixture consisted of 52.2 per cent sucrose, 12.7 per cent dextrose, and 35.1 per cent water. The ratio of sucrose to dextrose was 4.11 to 1.0 as compared with 25 parts sucrose and 7 parts dextrose or 3.57 to 1.0 as found by Dahlberg (N. Y. Agr. Exp. Sta. Bul. 536) to be most effective in preventing sugar crystallization in ices and sherbets. A.C.D.

The Limitations of Significance of Some of the Methods of Analyzing Ice Cream. A. C. FAY, Kansas State College, Manhattan, Kansas. Proc. 35th Ann. Conv. Intern. Assoc. Ice Cream Mfgrs. *2*, p. 49, Oct., 1935.

The standard plate count reveals the number of organisms in ice cream which will grow under the prescribed conditions of the test. Ice cream

frequently contains saccharophilic, heat resistant organisms which will not grow in plain agar. The small amount of sugar carried into the low-dilution plates frequently supports growth of these organisms although they will not grow in higher dilution plates. These saccharophilic organisms may also manifest a different property; some agar plates may appear nearly sterile unless examined under a strong lens. The colonies are present in the expected numbers in all dilutions but special lens equipment is necessary for counting the colonies. Parallel bacterial counts on 271 samples of Kansas ice cream, using standard agar and one per cent dextrose agar, indicate that the dextrose agar is more satisfactory with 56 per cent of the samples and of no value with the balance.

The direct microscopic count has the limitation that organisms killed by pasteurization are counted along with the survivors. Another limitation is the small sample of about 0.0001 cc. of mix which is actually observed.

The colon test is of value for the analysis of perfectly fresh milk or milk which has been kept very cold. Some colon types survive pasteurization and all types will grow in milk, hence the count of colon types is of significance when growth of the organisms in the dairy product has been prevented.

The accuracy of the methylene blue test for quality in milk varies because (1) the reducing intensity varies with different types of organisms and (2) it may be induced independently of bacteria by the organic constituents of milk or (3) by leucocytes in fresh milk. It is assumed that as bacteria increase in numbers, the flora of different milks becomes practically uniform in average reducing power. An arbitrary minimum for this uniformity is about 500,000 bacteria or a reduction time of 5.5 hours. The quality of most milk is considerably above this. M.J.M.

Improving Ice Cream Quality by the Proper Selection of Flavors. W. C. COLE, Univ. of Calif., Davis, Calif. Pacific Dairy Rev. *39*, 4, p. 10, April, 1935.

The importance of choosing vanilla, chocolate, fruit and miscellaneous flavors correctly for ice cream is discussed. Such added flavors determine the quality of the finished ice cream to a large extent. Uniform high quality should be the aim.

Of the factors considered in choosing flavors for ice cream the following seem to be the most important: (1) Consumer preference as to kind and grade of flavors. (2) Flavor quality as affecting the quality of the finished product. (3) Characteristic flavor remaining throughout the storage period. (4) Costs. W.C.C.

Federal and State Social Security Legislation. TIMOTHY J. MAHONEY, The Borden Co., New York, N. Y. Proc. 35th Ann. Conv. Intern. Assoc. of Ice Cream Mfgrs. *1*, p. 41, Oct., 1935.

The Social Security Act, which became a law on August 14, 1935, has as its principal objectives unemployment compensation, old age assistance and benefits, retirement pensions, aid to dependent children, and public health work. The bill provides for state participtation. Several states have enacted the necessary legislation and others have such bills under consideration. Every individual and every employer covered by the act are taxed at the same rate. For 1937, 1938, and 1939 the employees and employer both pay a tax equal to 1 per cent of the total salary of the worker. The tax rate is increased one-half per cent every three years until a maximum of 3 per cent is reached. Payments under the act vary under the different state laws but are proportional to the amount of money paid in by each worker.

M.J.M.

Ice Cream's Interest in Milk Control Programs. W. A. WENTWORTH, Secretary, Dairy Industry Committee, Washington, D. C. Proc. 35th Ann. Conv. Intern. Assoc. of Ice Cream Mfgrs. *1*, p. 26, Oct., 1935.

The various state and Federal Milk Control programs, how they operate, and how they may affect the dairy industry is the subject of this discussion. The six branches of the dairy industry are urged to coordinate their relations in a consideration of legislation affecting the industry. M.J.M.

Suggestions for the Manufacture of Chocolate Ice Cream. A. D. BURKE, Auburn, Alabama. Ala. Polytech. Mimeograph Leaflet, 1931.

Thirty-two different samples of cocoa and chocolate were studied in the preparation of chocolate ice cream. The ice cream mix used in the various tests was standardized to contain 13 per cent fat, 10.5 per cent serum solids, 15 per cent sugar, and 0.35 per cent gelatin. It was found possible to improve the flavor, body and texture, and melting resistance of chocolate ice cream by reducing the quantity of cocoa to 2.25 or 2.50 per cent as against 3.0 per cent most commonly used. Chocolate syrup to be added at the freezer was prepared by mixing together and processing in the usual way 1.00 pound cocoa, 0.75 pound sugar and 3.25 pound milk. This quantity was added to 40 pounds of partly frozen mix in the freezer.

When chocolate was used in place of cocoa it was necessary to make allowance for the additional fat content, using somewhat more in order to obtain the same intensity of flavor. A.D.B.

The Industry—Its Welfare and Future. ROBERT C. HIBBEN, Intern. Assoc. of Ice Cream Mfgrs., Washington, D. C. Proc. 35th Ann. Conv. Intern. Assoc. of Ice Cream Mfgrs. *1*, p. 20, Oct., 1935.

The author discusses the Federal laws recently passed and legislation under consideration which will have a direct effect on the ice cream industry. He also considers merchandising problems now before the industry.

M.J.M.

What Should I Know Before Buying an Ice Cream Freezer for Retail Manufacture? (No author given.) Intern. Assoc. of Ice Cream Mfgrs., 1105 Barr Bldg., Washington, D. C.

This bulletin is intended as a guide for retailers of ice cream who contemplate the purchase of freezing equipment. The bulletin should be helpful in determining probable operating and overhead costs. M.J.M.

The Association Simplified System. O'NEAL M. JOHNSON, Intern. Assoc. Ice Cream Mfgrs., Washington, D. C. Proc. 35th Ann. Conv. Intern. Assoc. of Ice Cream Mfgrs. *3*, p. 8, Oct., 1935.

The simplified system for accounting which has been developed for use in the ice cream business by International Association of Ice Cream Manufacturers, is outlined and discussed. M.J.M.

First Stockholm Plants Open. M. J. MACK, Mass. State College, Amherst, Mass. Ice Cream Field *27*, 4, p. 24, Aug., 1935.

It is stated that all ice cream manufactured in Stockholm, Sweden, is packaged in the factory and that most of the ice cream sold would be classified as novelties. Ice cream is considered a warm-weather confection in Sweden and is usually sold out of doors. W.C.C.

The Manufacture of Palatable and Uniform Ices and Sherberts. C. D. DAHLE, Penn. State College, State College, Pa. Ice Cream Field *28*, 4, p. 12, Feb., 1936.

The author gives the definitions adopted by Pennsylvania in 1934 for ices and sherbets. These standards include specifications for the amounts of organic acids and milk products that are permitted or required.

The recommendations of several workers in the field regarding the use of sugar and various stabilizers and are listed, but the author maintains he has not found it necessary to use corn sugar or stabilizers other than gelatin in making palatable and satisfactory ices and sherbets. W.C.C.

Where Accidents Are Most Likely to Occur. C. C. CLEMENT, National Dairy Products Corp., New York, N. Y. Ice Cream Field *27*, 4, p. 16, Aug., 1935.

The author gives a rather complete list of unsafe practices and conditions which are constantly producing accidents in the ice cream industry. W.C.C.

Fruit-flavored Mixes that Are Appetizing and Popular. C. D. DAHLE, Penn. State College, State College, Pa. Ice Cream Field *27*, 4, Aug., 1935.

Recipes which the author claims have proven popular are given for somewhat over a dozen different flavored ice creams. W.C.C.

The Newer Phase of Manufacturing Water Ices. B. I. MASUROVSKY. Ice Cream Field *27*, 5, p. 28, Sept., 1935.

It is reported that as a result of 176 tests sodium alginate was found satisfactory as a stabilizer for ice when used to the extent of 0.3 per cent, and mixed with the other ingredients at a temperature of 165° F. The overrun in the ices was found to vary from 10 per cent to 35 per cent during these tests which the author claimed was satisfactory. W.C.C.

How to Induce Buyers to Discriminate. F. L. KERNAN. Ice Cream Field *27*, 5, p. 10, Sept., 1935.

Educating people to discriminate in favor of high quality ice cream, and further to prefer ice cream in general to competitive products, are pointed out as being essential selling problems. People will usually accept most any grade of ice cream, it is stated, but if they are given an opportunity to choose between products of different quality the majority select those which are superior. Often, however, their reasons for making a particular choice are not convincing.

The author points out eleven common defects which may occur in ice cream and describes a simple way in which the layman can detect each. W.C.C.

How to Get the Desired Overrun in Freezer and Plant. C. D. DAHLE, Penn. State College, State College, Pa. Ice Cream Field *28*, 1, p. 16, Nov., 1935.

Several methods of calculating the overrun for ice cream are discussed and examples given to illustrate the variations in overrun of a given sample depending upon the basis of calculation. It is pointed out that theoretically the overrun should be figured on the basis of the material going into the mix and that recovered as ice cream. This obviously should include such factors as accuracy of weights, spillage and losses in the freezer.

The more commonly accepted recommendations are given for obtaining the desired overrun in the freezer. W.C.C.

Elements that Influence the Texture of Ice Cream. C. D. DAHLE, Penn. State College, State College, Pa. Ice Cream Field *28*, 3, p. 6, Jan., 1936.

The author discusses the texture of ice cream primarily from the point of view of the size of ice crystals. Many commonly accepted beliefs are presented. It is claimed that butterfat is more effective than are serum

solids in improving the texture of ice cream since the mechanical obstruction to the growth of ice crystals is greater in the former than in the latter case.

The effect of homogenization is claimed to be due primarily to the break up of the fat globules and the resulting increased mechanical obstruction to the growth of ice crystals. The advantages of rapid freezing are briefly presented form the standpoint of freezer design, temperature of freezing medium, forced ventilation in the hardening room, and proper manipulation of available equipment. W.C.C.

Processing the Ice Cream Mix for the Freezer. C. D. DAHLE, Penn. State College, State College, Pa. Ice Cream Field *27*, 5, p. 12, Sept., 1935.

The homogenization process is considered to perform the following functions: (1) prevents churning of fat during freezing; (2) improves texture of ice cream; (3) reduces aging time; (4) aids in obtaining overrun; (5) makes possible the use of butter, frozen cream, etc., in the mix and (6) produces more uniformity in mixes than could be had otherwise.

The two stage homogenizer is recommended for high fat mixes and those having high acidiites. Directions are given for standardizing the acidity in mixes when they are above the adopted standard, and a warning is given against reducing the acidity below that expected if the mix were made from the best dairy products. W.C.C.

The Correct Method of Freezing the Mix. C. D. DAHLE, Penn. State College, State College, Pa. Ice Cream Field *27*, 6, p. 28, Oct., 1935.

It is pointed out that the horizontal type freezer has been found to be the most satisfactory for commercial operation. In the case of brine freezers efficient operation requires that the strength of brine be carefully controlled to the desired concentration; further that the optimum temperature of the refrigerant will be influenced by the (a) efficiency of freezers, (b) freezing point of the mix, (c) condition of the blades and (d) volume of brine circulated.

Certain advantages claimed for the direct expansion and continuous freezer as compared with the brine freezer are indicated.

It is finally concluded, "To obtain the best texture, the ice cream mix should be frozen as quickly as possible and withdrawn at a temperature as low as possible without sacrificing overrun and then hardened as quickly as possible, consistent with economic practices." W.C.C.

Improved Babcock Method for Determination of Fat in Ice Cream. V. KNIASEFF. Ice Cream Rev. *18*, 6, p. 30, Jan., 1935.

A modified Babcock method for the determination of fat in ice cream is described, which has been devised and used in the laboratory of the

Bureau of Dairy Control of the California State Department of Agriculture. The method requires two reagents. Reagent No. 1 contains water, sodium hydroxide, sodium tartrate and ammonium sulfate. Reagent No. 2 contains ethyl alcohol, normal butyl alcohol, ammonium hydroxide, ethyl ether and petroleum ether.

The average results of a number of ice cream samples tested by the method described checked within 0.2 per cent of the Mojonnier method. Individual sample variations, when compared with the Mojonnier, ranged from – .28 per cent to + .37 per cent. J.H.E.

What a Doctor Thinks About Ice Cream. M. J. BREUER, Lincoln, Nebraska. Ice Cream Field *26*, 6, p. 18, April, 1935.

This physician highly recommends the use of ice cream. He states that from the point of view of tissue building and energy generated ice cream ranks far above many articles that are conveniently accepted by the public as "food."

The keynote of the value of ice cream in the dietary of the sick and undernourished is the fact that people like it, he claims. Because ice cream is cold and sweet it is often made the vehicle to carry to the patient many things he would dislike or refuse. W.C.C.

Ingredients Used in the Ice Cream Mix. C. D. DAHLE, Penn. State College, State College, Pa. Ice Cream Field *27*, 2, p. 8, June, 1935.

The products most commonly used in making ice cream mixes and the conditions under which their use is recommended are clearly presented. W.C.C.

How the Dealer Can Increase His Profits. E. G. STANTON, Chicago, Illinois. Ice Cream Field *27*, 2, p. 16, June, 1935.

It is pointed out that ice cream manufacturers should acquaint themselves with the fundamentals of soda fountain merchandizing and should in turn educate their dealers in these essentials. W.C.C.

Ice Cream in Reducing Diets Should be Promoted. (No author given.) Ice Cream Field *26*, 6, p. 16, April, 1935.

It is urged that if the many misconceptions on the part of those interested in reducing their weight could be corrected, much more ice cream would be sold. Some people pick out a few foods comparatively high in caloric value and shun them completely regardless of their food and health value. It is claimed that many women will refuse ice cream and eat apple pie because they have been taught that apples will aid in reducing and ice cream is so rich and fattening.

A suggestion is offered that charts of comparative calories of various servings of foods be used in a merchandizing program. Another suggestion is that the legal standard for fat in ice cream should be changed so as to eliminate the criticism that ice cream is too rich. W.C.C.

Preparing and Decorating Fancy Ice Cream. W. C. COLE, Univ. of California, Davis, California. Ice Cream Field *27*, 2, p. 11, June, 1935.

Directions are given for preparing some of the more common "fancy ice creams." W.C.C.

Recipes for Making Peach Ice Cream. JOHN CLAITOR. Ice Cream Field *27*, 3, p. 14, July, 1935.

The method described for using fresh peaches in frozen desserts consists essentially in removing the peels by plunging in boiling and then cold water, crushing the fruit and adding sugar at the rate of one part sugar to two parts fruit. Cool and freeze. Recipes are given for making peach ice cream, peach custard, peach pie, peach sherbet, as well as individual molds using these products. W.C.C.

Improving Flavor to Attract Repeat Trade. C. D. DAHLE, Penn. State College, State College, Pa. Ice Cream Field *27*, 3, p. 6, July, 1935.

The importance of properly selecting the ingredients of the mix as well as the flavoring used is discussed, especially with regard to the most common flavors, viz., vanilla, chocolate and strawberry. W.C.C.

How to Use Fruit to Flavor Your Ice Cream. H. A. ACKERMAN, Hydrox Corp., Chicago, Illinois. Ice Cream Field *27*, 1, p. 9, May, 1935.

It is claimed that canned fruits are generally inferior to fresh or cold pack fruits for use in ice cream, this being especially true in the case of strawberries and raspberries. Adding the fruit at the freezer just before drawing the ice cream is the procedure recommended for commercial practice.

According to the author raspberries retain their flavor better than do strawberries. In making peach ice cream a high fat mix and the generous use of cold pack peaches are recommended. W.C.C.

Methods of Determining Strength of Cleansing and Sterilizing Solutions in the Dairy Plant. E. F. ALMY, Dept. of Agr. Chem., Ohio State Univ., Columbus, Ohio. Ice Cream Rev. *19*, 1, p. 49, August, 1935.

Detailed procedures are given for the standard methods of determining the strength of cleansing and sterlizing solutions. J.H.E.

The Manufacture of Ice Cream in Cuba. KATHLEEN MOLESWORTH, Assist. Trade Commissioner, U. S. Dept. of Commerce, Havana, Cuba. Ice Cream Rev. *18*, 9, p. 64, April, 1935.

Estimates of ice cream production in Cuba place the daily average at 4,000 gallons. A brief description is given of merchandising methods and the quality of ice cream sold. J.H.E.

Freezing Cream, Ice Cream Mix for Use in Ice Cream. RALPH V. GRAYSON, Polar Products, Inc., Atlanta, Georgia. Ice Cream Rev. *18*, 10, p. 48, May, 1935.

De-aerating and freezing of milk or cream under a high vacuum into a slush, filling it into lacquer-lined tin containers, sealing under vacuum and hardening under extremely low temperatures is described as a successful way to store high quality milk and cream for consumption as the fluid product. J.H.E.

Thermal Computations in Quick Freezing Equipment. EUGENE A. TOOPEEKOFF. Ice and Refrig. *88*, p. 125, Feb., 1935.

The advent of quick freezing has resulted in entirely new equipment and new problems. The article points out that heat leakage through insulation in a sharp freezer in percentage of total demand for refrigeration varies from 29.2 per cent where the capacity is 2,126,000 cubic feet up to 42.3 per cent where the capacity is 333,000 cubic feet. In quick freezing on the other hand these losses are less than 4 per cent. Quick freezing is generally accomplished by the use of brine in the form of a mist or liquid in direct contact with the product to be frozen. Moving belts, floating pans, spray nozzles, diving bells, freezing plates, immersion cans, etc. have been made use of in designing equipment for quick freezing. L.C.T.

Minimizing Hazards in Operation of Refrigerating Systems. L. S. MORSE, Exec. Eng., York Ice Machinery Corp. Ice and Refrig. *89*, p. 187, Oct., 1935.

A list of regrigerant hazards together with a brief discussion of each is presented. A refrigerant confinement hazard arises when the interior pressure reaches the maximum which the confining vessel will withstand. To avoid explosions, relief valves should be used and set for about 250 pounds which is 25 pounds higher than the setting on pressure limiting devices.

Other refrigerant hazards consist of leaks, hot water backing up into condenser in small commercial plants, lack of water, high normal water temperature, condenser in direct rays of sun, overcharging system, drawing air into system, leaking or fractured joints, and overloading refrigerant drums. L.C.T.

Preserving Citrus Juice by Freezing. Wm. J. Finnegan, Consult. Eng., Los Angeles, California. Ice and Refrig. *88*, p. 51, Jan., 1935.

The Sunset Packing Corporation of Pasadena, California, makes use of a tubular freezer (U. S. Patent 1925033, Aug. 29, 1933) for quick freezing of citrus juice packed in vacuum sealed tin cans. The freezing tubes are 20 feet in length and of such diameter that a uniform restricted, turbulent brine flow takes place over the entire surface of the can as it passes through the tube. The time required to totally solidify round cans six inches in diameter is 46 minutes. The container in passing through the tube turns more than a complete revolution in the travel of its own length. This results in uniform heat transfer and the location of the vacuum in the center of the frozen mass. Due to the velocity of the brine over the cooling surface, the overall coefficient of heat transfer is great even though the brine is only at $-28°$ F.

The paper ends with a brief discussion of heat transfer and thermal conductivity, and raises a number of questions which confront investigators of overall coefficients of heat transfer. Freezing data are included. L.C.T.

Notes on Cork Insulation. P. Edwin Thomas, Mgr. N. Y. Offices, United Cork Company. Ice and Refrig. *88*, p. 370, June, 1935.

The author discusses the development of cork tissues, and points out how it differs from the woody part of a tree. This difference is the reason why moisture cannot migrate in cork as it might in Balsa wood. Special properties of cork are described. The air cells constitute about 54 per cent of normal cork. On analysis by treatment with nitric acid, cork shows the following solid matter:

Cellulose	0.18 parts
Resin	14.72 "
Oxalic acid	16.00 "
Suberic acid	14.40 "

When preparing cork insulation it must be properly granulated, so that pressure will not collapse the natural cells. It must be properly baked so as not to explode the air cells, but at the same time fry out the natural resin to bind the particles together in a compact permanent mass.

Reason for failures of cork insulation are discussed. Air proofing of all surfaces is advisable, since refrigeration tends to create a vacuum effect in a cold storage room. Brief instructions for proper wall construction are presented. Outside walls should be waterproofed with asphalt and the inside surface of the cork should be covered with two coats of an emulsified asphalt plastic finish. L.C.T.

Methods of Freezing Fruits and Fruit Juices. DONALD K. TRESSLER, N. Y. Agr. Exp. Sta., Geneva, N. Y. Ice and Refrig. *88*, p. 275, April, 1935.

The author presents a brief history of quick freezing as applied to the fruit industry. A number of the problems encountered in quick freezing of fruits are discussed. Enzymes in particular are objectionable. Their effect may be minimized by the use of a moderate amount of sugar. Sugar also prevents the loss of volatile flavors as found in strawberries and raspberries. Oxidation or blackening of cut surfaces is also prevented by keeping the fruits under a sugar syrup.

Cranberries, raspberries, blueberries, plums and youngberries are usually frozen whole, while apples, peaches and pineapples are sliced. Strawberries are packed both whole and sliced. Oranges, apples and grapes are sometimes converted into juice and frozen. Strawberries may be packed with two, three or four parts of berries to one part of sugar.

A number of methods have been developed for preventing discoloration besides the use of sugar syrup. Salt brine, pineapple juice, sulphur dioxide, or vacuum treatment for apples. Citric acid may be used with peaches. Good fruit and the right variety is necessary for quick freezing. L.C.T.

MILK

Certain Problems Related to the Marketing of Homogenized Milk (continued from January issue). P. H. TRACY, Univ. of Illinois, Urbana, Ill. The Milk Dealer *25*, 5, p. 60, Feb., 1936.

The author draws the following conclusions from his work on homogenized milk:

1. Homogenized milk has proved popular with the University of Illinois milk customers primarily because of the richer flavor that the milk has, its homogenous nature, its convenience, and general adaptability for kitchen use.

2. The curd tension of milk can be reduced by homogenization. The temperature to which the milk is heated is also important. As the pressure of homogenization is increased the curd tension is reduced. However, little is to be gained by increasing the pressure beyond 2000 pounds. Somewhat lower curd tension will result from homogenization at temperature below 140° F. Mixed milk processed under similar conditions during the year will vary in the degree of curd hardness. In the period from September to June, the lowest readings were obtained in January and the highest in October.

3. Sediment in homogenized milk is due to the settling of body cells and possibly destabilized protein. The temperature and pressure of homogenization are not important factors. Clarification before homogenization will reduce the amount of sediment and clarification after homogenization will prevent the defect entirely.

4. Milk should be processed at temperatures not lower than 116° F. and and at a pressure not lower than 2000 pounds in order to emulsify the fat completely enough to prevent creaming.

5. Homogenized milk can be satisfactorily tested by the Babcock method. It is desirable to have both acid and milk at about 70° F., to add the acid in small portions and to shake after each addition. Slightly less (1.5 cc.) acid is necessary.

6. Homogenized milk has less color than regular milk as measured by the K. and E. color analyzer.

7. There is less churning of fat in milk that has been frozen and thawed if the milk is previously homogenized. Milk homogenized at 2000–3000 pounds and then frozen will have a normal appearance when melted.

8. Homogenized milk is more sensitive to the action of sunlight than regular milk. This defect is likely an effect of the light upon the milk protein and may be more noticeable in homogenized milk because of the increased protein surface. Milk homogenized in the raw state will rapidly become rancid unless immediately heated to pasteurizing temperatures.

Milk homogenized at the pasteurizing temperature may acquire a cooked flavor due, possibly, to the temperature increase resulting from the homogenizing process and the increased protein surface.

9. The homogenizer is a source of bacterial contamination if not properly cared for. This accounts for the common complaint that homogenized milk does not keep as well as regular milk. C.J.B.

Functions of a Milk Marketing Control Program. C. A. Abele, Alabama State Dept. of Health. The Milk Dealer *24*, 12, p. 60, Sept., 1935.

A discussion of the various elements of which a state milk marketing control program should consist. These various elements are listed as follows:

1. Limitation of the sale of milk, in any particular marketing area, to that from sources fully conforming to public health regulations, by means of licensure.

2. Unification and limitation of the differential between retail and store resale prices, and the limitation of the spread between wholesale prices and store resale prices.

3. Establishment of a sliding ratio which the prices paid to producers shall bear to the average wholesale-retail price of milk.

4. Bonding of distributors, to assure milk producers of payment for milk delivered.

5. Elimination of trade practices inimical to the best interests of the fluid milk industry, such as rebates, discounts, combination sales, extensive distribution of free samples, etc.

6. Advocacy of the adoption of the latest form of the State Board of Health Milk Regulations.

7. Careful study of the questions of limitation of production and price stabilization in each market area, the results of the study to determine the action taken.

8. Encouragement of (a) adjustment of financial obligations of milk producers and distributors, (b) the development of concentrated efforts by all existing state agencies toward the more economical production of milk, and (c) the use of any available direct or revolving relief funds for rehabilitation of dairy and milk-plant structures. C.J.B.

Comparative Efficiency of Farm Milk Coolers. G. H. WILSTER, H. HOFFMAN, AND F. E. PRICE, Oregon Agr. Exp. Sta., Corvallis, Oregon. Oregon Agr. Exp. Sta. Bul. 331, June, 1934.

The study involved the cooling efficiencies of a tubular surface cooler, a sprinkler cooler, a tub cooler, and a Hydro-Vac cooler. The last-named cooler can be placed on a shipping can and attached to the water supply by means of a hose. As the water enters the cooler it goes through a water jet, creating a suction which may eliminate odors from the milk. The water is projected against a water wheel, which turns a small propeller in the can and finally flows in a continuous film down the sides of the can.

With the surface cooler, it was found that the rate of flow up to six gallons per minute, the temperature of the water, and the rate of milk flow over the cooling surface all markedly affected the rate of cooling and the final temperature attained by the milk. With the Hydro-Vac cooler the length of the cooling period and the temperature of the cooling water affected the time required to cool milk to its final temperature.

In five tests with a surface cooler using 80 pounds of milk at 90.4° F., the water flowing at the rate of four gallons per minute at 52° F., it required ten minutes to cool the milk to an average temperature of 56.7° F. Under the same conditions the Hydro-Vac cooled the milk to 59.5° F. With the cooling water at 54° F. and water flowing at the rate of four gallons per minute, it required 15 minutes with a Hydro-Vac cooler, 60 minutes with a sprinkler cooler, and 90 minutes with a tub cooler to cool 80 pounds of milk from 90° to 58° F.

The bacterial contamination in the milk cooled by a sterilized tubular surface cooler and with a sterilized Hydro-Vac cooler showed that in either case the contamination was very small. The sterilized surface cooler would add only 0.62 bacterium per cc. of milk during cooling, while as a result of the contact with the air only 0.05 bacterium per cc. milk would be added.

When milk from the same lot was cooled with a surface cooler, with a Hydro-Vac cooler, and with a tub cooler, three qualified judges were unable to find much difference in the flavor of the milk cooled with the surface

cooler, or Hydro-Vac cooler, but the milk that was cooled in a tub had a less desirable flavor. G.H.W.

The Spread Between Farm and Retail Prices for Milk. LELAND SPENCER, Cornell Univ., Ithaca, N. Y. The Milk Dealer *24*, 12, p. 32, Sept., 1935, and *25*, 1, p. 72, Oct., 1935.

Data are presented showing the spread between farm and retail prices for milk in various United States markets and especially in New York City. Illustrations are given showing the variations in spread brought about by changes in purchasing price and in retail price. Data are also presented showing the make-up of retail prices and the cost of distribution of milk in the New York metropolitan area.

The author points out that milk dealer's spread can be determined accurately only by taking the difference between the amount received for all milk and milk products sold by the dealer, and the amount paid for all milk and milk products purchased. That the first step in analyzing the dealer's spread is to recognize that it consists of two elements; namely, the cost of doing business, and profit. The author concludes from the facts at hand that while profits vary considerably from time to time and among various dealers in the same market, it appears certain that the profit item rarely, if ever, constitutes more than one-tenth of the total spread. Ninety per cent or more of the milk dealer's spread is absorbed by the cost of the several operations and services that are performed in the process of getting the milk from the farm to the consumer. C.J.B.

What Causes Most Common Off Flavors in Market Milk? W. H. CHILSON, Am. Dy. Sci. Assoc., Dairy and Ice Cream Machinery and Supplies Assoc. Fellow, Cornell University, Ithaca, N. Y. Milk Plant Monthly *24*, 11 and 12, p. 24 and 30, Nov., Dec., 1935.

The author lists the factors contributing the flavor of milk and points out the prevalence of oxidized flavor particularly in milk of low bacterial count. It is suggested this flavor may be a factor interfering with increased milk consumption.

The review of literature contains detailed summaries of recent experimental work on oxidized flavor of milk. Much data incident to the present study are given.

Oxidized flavor was found to develop in milk from 25–30 per cent of the cows of the Cornell herd when that milk was held at a low temperature. Metal salts accelerated the development of the flavor. However, it was not necessary for the milk from some cows to come in contact with metals for the development of the oxidized flavor. The oxidizing enzyme seemed to be present in smaller amounts during the hot months than the cold months.

This enzyme was destroyed by heating to 170° F. for 10 minutes. Copper sulphate will cause the production of an oxidized flavor in milk heated to this exposure if added in relatively large amounts. Reconstituted 4 per cent milk made from this high heat treated milk did not develop the oxidized flavor.

Reducing agents prevented the development of the oxidized flavor. Ascorbic acid (Vitamin C) added to the rate of 50–60 milligrams per liter prevented the oxidized flavor development for seven days. All vitamin C was found to be oxidized by the time the oxidized flavor was noted. The typical oxidized flavor appears to be due to the oxidation of the lecithin while tallowy flavor was the result of oxidation of oleic acid. G.M.T.

Citrus Juice-milk Products. W. E. Baier, Rsh. Dept., California Fruit Growers Exchange. The Milk Dealer *25*, 5, p. 41, Feb., 1936.

The author discusses the merits of beverages composed of milk mixed with citrus fruit juices. C.J.B.

Some Thoughts on Merchandising Fluid Milk. The Milk Dealer *25*, 1, p. 90, Oct., 1935.

Approximately 18 per cent of 3,413 selected, representative families interviewed in the Philadelphia area specifically stated that they did not know what price they paid for milk. Over 90 per cent did not know the retail price of cream.

Of 2,768 families reporting on type of container, 54 per cent preferred the glass bottle, 16 per cent the paper container, and 30 per cent did not have any preference.

Data are also given showing the number of these families buying milk from retail wagons and from stores; the length of time milk has been purchased from one dealer, reasons for changing dealers, reasons for buying from stores, and reasons for buying the different grades of milk. C.J.B.

Aluminum in the Milk Plant. The Milk Dealer *25*, 5, p. 44, Feb., 1936.

The ideal characteristics of materials used in milk plants are listed as follows:

1. Absolute insolubility of the material in dairy products under all conditions.
2. Insolubility in cleaning solutions, sterilizers, and cooling units.
3. Non-toxic and has no effects on flavor, color, or keeping quality or dairy products.
4. Attractive appearance.
5. Sufficient strength to resist high pressure, rough usage, and considerable scrubbing.

6. Excellent workability and availability in castings, seamless tubes, sheet, and other forms used in the fabrication of milk-plant equipment. This would include perfect welding.

7. Resistance to electrolysis.

8. Low cost

A discussion is then given showing how aluminum meets the above characteristics. A list of cleaners for use with aluminum dairy equipment is also given. C.J.B.

EDITORS' NOTE: Plant operators should not lose sight of the fact that aluminum is readily attacked by certain alkaline cleaning solutions and that it is subject to electrolysis when in electrical contact with other metals.

Alkalinity Control of Washing Solutions. H. W. LEHMKUHL, Rochester, N. Y. Proc. of the 28th Annual Convention of Intern. Assoc. Milk Dealers, Lab. Section, p. 43, 1935.

Objections to two present methods of control of concentrations of washing solutions are discussed and the author proposes the use of hard fused briquets of anhydrous trisodium phosphate and sodium carbonate which are compact and slowly soluble. With these a very simple feed device is employed which has the following features: A tank holding the briquets with a wide unconstricted line leading from the bottom of the briquet tank to the wash tank. A fresh-water feed device consisting of a cup with a regulator valve outlet and an overflow which passes some of the water to the bottom of the briquet feed tank. The briquet tank will contain 20–25 pounds of this fused material in large excess of the amount required for a day's operation. The purpose of the fresh-water bypass is to dilute the concentrated solution formed at the outlet of the briquet tank. The water drip feed is of the swivel type and may be thrown off-center at any time during operation and the alkalinity feed thus discontinued.

A study of 100 installations of the briquet feed type alkalinity control have been made.

An alkalinity of 0.05 – 0.10 per cent (to phenolphthalein and expressed as sodium hydroxide) and about one pound per 200 cans is an average consumption.

Further study is needed to determine what variations in procedure are needed to adapt the briquet method to bottle washing. E.F.G.

Most Desirable Composition of Chocolate Milk. R. S. CRAIG, Director Sanitary Section, Baltimore City Health Dept. Proc. of the 28th Annual Convention of Intern. Assoc. Milk Dealers, Lab. Section, p. 38, 1935.

Trade practice and consumer preference are in harmony with the minimum fat content of 2.5 per cent required by the Baltimore Health Depart-

ment. The permissible maximum cocoa content of 5 per cent and added sugar if not more than 6 per cent preclude any criticism of the product on account of too high concentration of either of these products from health standpoint. E.F.G.

A Review of Federal and State Milk Control Experience. R. B. CORBETT, U. S. Dept. of Agr., Washington, D. C. Proc. of the 28th Ann. Convention Intern. Assoc. of Milk Dealers, General Sessions, p. 74, 1935.

Legal experience with milk control reveals a tendency to carefully preserve the fundamental relationships between the several states and the federal government as set forth by the constitution.

Economic experience with milk control shows an increased price to producers but that production has been influenced as much by drought and natural factors as by milk control. Consumption has not greatly changed and spreads for distribution have increased somewhat where resale prices have been set. The rapid growth in evaporated milk sales has not continued in 1935.

Lack of enforcement has been the most serious drawback to attainment of the objectives of milk control.

Accurate data are needed to show the true effects of milk control as an economic factor. E.F.G.

The Bottle Exchange—Its Relation to the Milk Industry. W. A. MCDONALD, McDonald Dairy Co., Flint, Michigan. Proc. of the 28th Annual Convention Intern. Assoc. Milk Dealers, General Sessions, p. 62, 1935.

The organization and functioning of a bottle exchange in Flint, Michigan is described. The total operating cost is given as forty-five one-hundreths of a cent ($0.0045) per unit.

In this expense is included the matching of all individual producers' contributions to the Flint Dairy and Food Council as well as other activities calculated to promote the general good of the industry. The author expresses the opinion that a milk bottle exchange should confine itself as closely as possible to the essential functions of an exchange. A detailed profit and loss statement of the Flint Bottle Exchange is appended.

E.F.G.

Causes and Practical Methods for Control of Sedimentation in Homogenized Milk. D. A. CHARLES AND H. H. SOMMER, Univ. of Wisconsin, Madison, Wis. Milk Plant Monthly *24*, 4, p. 26, April, 1935.

The introduction of the homogenization process to the market milk industry has brought forth the problem of sediment in the bottled product.

This sediment is probably of the nature of separator slime, but is prevented from settling out of the unhomogenized product by the rising action of cream. The white portion is present in normal milk while the dark portion is picked up on the farm of production. Since the sediment is so fine it escapes detection on the sediment disc.

No relation between heat stability of the milk before or after homogenization and the amount of sediment was found. The action of large amounts of citrates and phosphates in reducing the white sediment was probably due to the tendency toward solubility of the proteins.

The sediment was not adsorbed material from fat globules nor was it due to agglutination of particles during homogenization. Clarification following homogenization while the milk was yet hot promises to be a practical method for commercial control of this defect. G.M.T.

What is Bottled Concentrated Milk? R. B. Stoltz, Ohio State Univ., Columbus, Ohio. Milk Plant Monthly *24*, 3, p. 52, March, 1935.

Bottled concentrated milk, known also as Fresh Concentrated, Fresh Evaporated, Double Rich, and Duo-Rich Milk is milk which has had about one-half the water removed, after which the product was bottled in glass bottles and sold fresh to the consumer. This concentrated milk could then be diluted back with tap water to the composition of normal milk or used in the concentrated state as the consumer desired.

Perry W. Meredith, Fellow, American Dairy Science Association and the Dairy and Ice Cream Machinery and Supplies Association, working on the problem of bottled concentrated milk brought to light many interesting data on the subject.

A typical group of over 100 consumers were quite willing to use the concentrated product, preferring to use the product in concentrated form on cereals and in coffee. No appreciable differences between the original milk and the diluted product were detected. The keeping qualities of the concentrated milk were slightly better than those of the original pasteurized milk. The processing of the milk in the vacuum expelled some of the feed flavors as well as some of the desirable flavors. Cream layer formation occurred after four days. Homogenization was necessary. Sediment was noticeable in the bottled product unless clarification was resorted to after homogenization. Curd tension, pH, specific gravity, fat, total solids, viscosity, and titratable acidity were only slightly altered by condensing and diluting back. The cost of condensing ranged from 0.42¢ to 2.67¢ per quart, depending on several factors. G.M.T.

The Present Status of High Temperature Short Time Pasteurization of Milk. R. E. Irwin, Penn. Dept. of Health, Harrisburg, Pa. Milk Plant Monthly *24*, 3, p. 24, March, 1935.

High temperature short time pasteurization is used in 76 milk plants located in 12 states. These plants are distributed chiefly in Pennsylvania and New York. The points of interest to control officials and milk distributors relative to this type of pasteurization are:

1. Less floor space. Less equipment.
2. Less time required to heat the milk and clean the equipment.
3. Sterilization with hot water of all surfaces with which the milk comes in contact immediately before the milk enters.
4. Milk to milk regeneration reduces the cost of heating and cooling.
5. Elimination of dead ends, leaking valves and foam.
6. Removes the incentive and makes it difficult to underheat or shorten the holding time.
7. Destroys the usual gas forming organisms and prevents reinoculation in the pasteurizing equipment.
8. Improves the flavor of the treated milk by making long time holding unnecessary and by preventing excessive numbers of thermophilic organisms.
9. Provides a softer curd, thus more easily digested.
10. Prevents the destruction of vitamin C through oxidation.
11. Cream separation is regulated by varying the heating and holding time and the temperature.
12. The treatment of the milk may be carried on under pressure in closed equipment.

The Electropure, Stamwik, Creamery Package Precision, Kaestner Faultless, Cherry-Burrell, Isotherm, Cherry-Burrell Plate, Dairy Supply and Equipment Plate, and York Plate types of equipment are fully described and illustrated. G.M.T.

Properties, Virtues, and Possible Drawbacks of Homogenized Milk. P. H. Tracy, Univ. of Illinois, Urbana, Ill. Milk Plant Monthly *24*, 4, p. 28, April, 1935.

The unpopularity of homogenized milk in the past was probably due to the stress placed upon cream layer and to the unfriendly attitude of some health and regulatory officials who felt that homogenization might encourage the use of substitutes for butterfat or the use of butter and skimmilk powder in place of normal milk.

Ten per cent of the University of Illinois milk route customers changed to homogenized milk after one trial. Later another 25 per cent changed to this product. Some reasons given for their preferences were:

1. Looks and tastes richer.
2. No cream adheres to bottle cap and to top of bottle.
3. No mixing necessary.
4. Better for breakfast foods.
5. No temptation to remove the cream.

6. Easy to prepare for infant feeding.
7. No cream rises to top of glass in refrigerator.
8. Makes fine milk drinks.
9. Children like it better.
10. Baby does better on homogenized milk.
11. Does not churn out when it freezes.
12. Adults would never drink other types of milk.

Experiments show there was a tendency toward fat globule rising in low pressure homogenized milk at widely varying temperatures of processing. Flashing the raw milk to 140° F., homogenizing at 2000 pounds' pressure, clarifying, and pasteurizing is suggested to give best results. Clarification is necessary to avoid sediment. The regular Babcock test can be used in making the fat tests, but care must be exercised in regard to temperatures, amount of acid, strength of acid and agitation.

The homogenizer itself may be an important source of contamination. G.M.T.

Standardizing Milk and Cream by Centrifugal Force. D. H. NELSON, Univ. of Calif., Davis, California. Milk Plant Monthly *24*, 6, p. 36, June, 1935.

Calculations show that the centrifugal force used in standardizing milk does not seriously affect the solids-not-fat content of the milk. G.M.T.

The Use of Plastic Cream in Making Whipping Cream. C. D. DAHLE, R. C. WELCH, AND A. O. SHAW, Pa. Agr. Exp. Sta., State College, Pa. Milk Plant Monthly *24*, 8, p. 27, Aug., 1935.

Experiments were conducted to determine the possibilities of making whipping cream from plastic cream, containing around 80 per cent fat. From these studies the authors conclude that:

1. Plastic cream or heavy cream containing over 59.5 per cent butterfat will show a cream plug on the surface and a tendency to oil off when standardized with skimmilk to make whipping cream unless mechanical means are taken to prevent this.

2. Viscolizing pressures of 40 pounds or more are needed to prevent oiling, 80 to 100 pounds are needed to produce a product that is not coarse in appearance, but at such pressures the whipping time is greatly increased.

3. Colloid mills proved to be efficient means of producing very satisfactory whipping cream from plastic cream and frozen cream. G.M.T.

Quality Promotes Quantity, Increasing Milk Consumption with Quality Milk. M. J. ROSENAU, Pres. Amer. Assoc. of Med. Milk Comm., Prof. Emeritus of Preventive Medicine and Hygiene, Harvard University.

Proc. of the Twenty-eighth Ann. Convention, Intern. Assoc. of Milk Dealers, p. 133, 1935.

Increase in per capita consumption of milk to a peak of 40.8 gallons per year in 1929 is attributed to a growth of public confidence in this food.

About five years ago pasteurized certified milk was placed on the Boston market and today the demand for pasteurized certified milk exceeds that for raw certified milk in this city. In June, 1935, the American Association of Medical Milk Commissions amended the official methods and standards for certified milk to permit pasteurization. Several cities in which certified milk is pasteurized are named. The pasteurized product now averages less than 100 bacteria per cubic centimeter.

Certified milk should receive favorable public response from calling the attention of the public to the high quality of certified milk through the addition of this new safeguard, pasteurization. E.F.G.

Court Decisions on Milk. JAMES A. TOBEY, The Borden Company, New York City. Proc. 28th Annual Convention Intern. Assoc. Milk Dealers, p. 125, 1935.

Some early court decisions relative to milk are cited. The decisions of courts of final appeal must be consulted in order to determine the legal principles applicable to milk control in the U. S. There are to date more than 250 separate decisions. Eight U. S. Supreme Court decisions furnish certain legal principles which the author enumerates. The I. A. M. D. plans to publish a comprehensive pamphlet on the legal aspects of milk control. E.F.G.

Fundamentals in Efficient and Safe Cleaning of Dairy Equipment. F. E. A. SMITH, Dairy Tech. Service Dept., The Diversey Corporation. The Milk Dealer *24*, 3, p. 34, Dec., 1935.

This paper is a discussion of the importance and means of cleaning dairy utensils. C.J.B.

The Value of Milk Judging Contests to the Milk Dealer. W. H. E. REID, Dairy Dept., Univ. of Misouri, Columbia, Mo. The Milk Dealer *25*, 5, p. 38, Feb., 1936.

A discussion of how milk judging contests train the participants therein not only to judge milk but to produce and handle milk so that it will be of high quality. C.J.B.

The Promotion of Fluid Milk Sales in Australia. S. M. BALLANTYNE, Russell Gildberg Advertising Pty., Ltd., Melbourne, Australia. The Milk Dealer *25*, 5, p. 43, Feb., 1936.

An explanation of the lack of advertising of dairy products in Australia. C.J.B.

The Expanding Horizon of the Dairy Industry. CHESTER P. HOLWAY. Nat. Butter and Cheese J. *26,* 13, p. 26, July 10, 1935.

The expansion of the dairy industry into Southeastern and Northwestern states offers a new mode of life to farmers in the single crop areas and is a threat to the markets of established dairy states. A survey of opinions of state departments of agriculture in 48 states and Hawaii indicate that the desirable consumption of dairy products can be increased by organizations with definite plans to educate the people to the quality and value of dairy foods. W.V.P.

Production of High Quality Milk and Cream. C. C. PROUTY, Washington State College, Pullman, Wash. State Coll. of Wash. Agr. Exp. Sta. Bul. 192, 1934.

The author describes in a short concise manner, easily understood by the farmer, how to produce high quality milk and cream. N.S.G.

Milk Bottle Containers for the Home Help Eliminate Customer Complaints. The Milk Dealer *25,* 6, p. 48, March, 1936.

Dairies reporting favor the use of bottle containers for the home, as they mean satisfied customers, less exposure of the bottles, less delivery trouble, and less bottle breakage. C.J.B.

All-Purpose Cream. J. EDWARD TUFFT. The Milk Dealer *25,* 6, p. 50, March, 1936.

The author describes how Arden Farms, Inc., of Los Angeles, has successfully introduced an "all-purpose cream" with a butterfat content of 31 per cent. Sales have increased markedly, particularly in quart units. C.J.B.

Abnormal Flavors and Odors of Milk. J. PIEN AND S. HERSCHDOERFER. Le Lait *15,* p. 1, p. 143, p. 257, 1935.

Causes for abnormal flavors and odors in milk are the following: (1) accidental introduction of odiferous substances into the milk or the presence of such substances in the dairy where the odors may be absorbed by the milk; (2) introduction in the ration of feeds which contribute abnormal flavors, examples of such feeds being rape, cabbage, beet leaves, and many others; (3) changes in milk flavor and odor due to bacterial action, malt flavor, caramel flavor, medicinal flavors, etc.; (4) changes in flavor due to physico-chemical phenomena such as exposure of the milk to sunlight, presence of ozone or copper salts in the milk, etc.; (5) enzymic changes due

to the action of hydrolytic or oxidative enzymes on the fat; and (6) diverse changes due to the formation of trimethylamin with consequent fishy flavor from lecithin which has undergone decomposition.

The first of these flavor defects may be eliminated by proper aeration of the dairy and by keeping all odiferous materials away from dairy products. The second may be obviated by removing from the ration those foods which are known to produce off flavors in the milk or by supplying these foods to the cows as distant from the milking time as possible in order to allow the odiferous constituents to be respired. Off flavor due to bacteria may be eliminated by proper sanitary precautions around the dairy and by prompt and proper pasteurization of the milk. The deleterious effects of sunlight, copper salts and ozone on the flavor of milk may of course be prevented by removing the milk from conditions where these factors become operative. The effects of oxidizing enzymes which bring about tallowy flavors in the milk may be controlled by removing from the ration of the cow feeds high in unsaturated fats, by preventing contamination of the milk with copper salts, copper operating to catalize the production of the tallowy flavor and by introducing into the ration feeds high in their content of antioxidants. The addition to the milk of reducing organisms is also mentioned as a means of reducing the effect of the oxidizing enzymes. The effect of hydrolysing enzymes, which operate to give the milk a rancid flavor, may be prevented by prompt pasteurization of the milk. The fishy flavor due to the decomposition of lecithin may be prevented by prompt pasteurization of the milk and proper care of the milk subsequent to pasteurization. A.H.J.

What Happens to the Cream in Paper Milk Containers. THOMAS DURFEE, W. S. ARNOTT, AND R. R. NELSON, Applied Res. Lab., Dayton, N. J. The Milk Dealer *25*, p. 40, Nov., 1935.

Data are presented showing the amount of cream rising on milk in paper bottles and on milk in glass bottles. C.J.B.

Efforts to Organize and Improve Market Milk in France. A. TAPERNOUX, Prof. of Chemistry at the Veterinary School at Lyon. Le Lait *15*, p. 480, 1935.

Milk consumption in various parts of France and in various large cities is compared. With improvement in milk quality, there has paralleled a decrease in death rate among infants. A.H.J.

Detergents Employed in the Dairy Industry. G. GENIN. Le Lait *15*, p. 868, 1935.

The various alkalies employed as detergents in the dairy industry are discussed and the mechanism of their action is reviewed. A.H.J.

The Pasteurization of Milk, Its Advantages and Disadvantages. (Low temperature pasteurization.) G. GENIN. Le Lait *15*, p. 1101, 1935.

The advantages of pasteurization are considered to be the production of a safe milk and superior keeping quality. The disadvantages are considered to be the impossibility of producing a satisfactory milk by pasteurizing a poor milk, a reduction in the quantity of cream and the modification of the milk proteins and milk salts, with possible impairment of the nutritive properties. Vitamins A, B1, B2, D and E are stated not to be affected by pasteurization, while C is rather readily destroyed, especially in the presence of oxygen and certain metals. A.H.J.

A Coefficient of Cleanliness for Milk. A. FOURNIER. Le Lait *15*, p. 1077, 1935.

It is proposed that coefficients of cleanliness be calculated for milk on the basis of solid contaminants (which may be filtered out and weighed) and on the basis of added water. Coefficients of alteration for milk are also proposed based on changes in composition of the milk such as changes in acidity, etc. A.H.J.

A Microbiological Study on the Filtration of Milk. J. MASEK, Polytechnic Institute at Prague. Le Lait *15*, p. 954, 1936.

The filtration of milk through clean filters removed considerable numbers of bacteria as determined by making plate counts in the milk before and after filtration. Contaminated filters may, however, cause an increase in the bacterial count of the filtered milk. A.H.J.

The Sterilization of Dairy Equipment by Dry Heat. G. GENIN. Le Lait *16*, p. 30, 1936.

A review of the literature on this subject is presented. A.H.J.

The Flavor Defects of Milk (Oily-Rancid, Tallowy and Bitter Flavors). JOSEF PROKS AND JAROMIR GROH. Le Lait *15*, p. 370, 1935.

Oily-rancid, bitter, and tallowy flavors are found in the milk independent of the feed given the cows. The milk of all the cows in any herd is not defective but only the milk of some of the cows. The flavor defect is not continuous but appears and disappears in the milk from time to time. Moreover, the intensity of the off-flavor varies. The flavor defect increases not only in the winter but also in early summer. In most of the cases studied, the off-flavor was found in the milk from cows in advanced stages of lactation. The oily-rancid and sometimes the tallowy and bitter flavor defects are of such a nature that if the milk is heated before the flavor has developed, its development may be prevented. Keeping the milk at temperature

to +10° C. is favorable to development of the flavor defect. Keeping the milk at temperature of 18 to 20° C. allows less rapid development of the flavor than keeping the milk at +10° C. Contact of the milk with certain metals accelerates the development of the off-flavor but such flavors may develop in certain milk which has experienced no contact with metal. Coincident with the appearance of the flavor defect, there begins a degradation of the fat to yield flavor substances soluble in water. The lipolytic enzyme which causes the degradation of the fat is found in the skimmilk. The oily-rancid and ultimately the bitter and tallowy flavors were not caused, in the cases examined, by microorganisms. Lipolytic enzymes were considered responsible for the development of the off-flavors. The degree of off-flavor developed was proportional to the quantity of lipolytic enzyme present. Different quarters of the udder of the same cow produced milk of varying lipolytic activity. The fermentation of milk with lactic organisms reduces the rate of development of the flavor defect but does not prevent it. A.H.J.

The Health Benefits of a Community Nutrition Program. Olive B. Cordua, San Diego, California. Pacific Dairy Rev. *39*, 9, p. 10, Sept., 1935.

The value of a community nutrition program is set forth. It is pointed out that in dealing with the school and pre-school child we reach 39 per cent of the population. Three pertinent questions have to be answered: *Whom* are we going to teach? *What* are we going to teach? *How* is the material to be presented. All agencies should come together in a well coordinated unit if proper progress is to be made. P.A.D.

The Use of Dry Skimmilk in the Manufacture of Cultured Milk. E. E. Alldredge and A. D. Burke, Russellville and Auburn, Alabama. Ala. Polytech. Inst. Exp. Sta. Bul. 239, 1933.

A total solids content in the reconstructed skimmilk of 10.0 ± 0.2 per cent, was found most desirable from the standpoint of producing a desirable flavor, body, and texture. The dry skimmilk should be thoroughly dissolved and the reconstructed product heated to 180° F. maintained for 30 minutes, followed by immediate cooling to 68–70° F. Five per cent of added starter was found to be satisfactory in the development of the proper acidity, flavor, body, and viscosity. An acidity of 0.95 to 1.00 per cent in the finished buttermilk was most satisfactory from the standpoint of flavor in that the relatively high acidity tends to mask the slightly heated flavor apparent in the finished product. Flavor improved after 24 hours' storage at a cold temperature. In all tests it was found desirable to cool the cultured buttermilk to 50° F. or lower prior to breaking the curd.

Vigorous agitation of the curd, particularly to the point of even slight foaminess, was responsible for major defects of cultured buttermilk, especially the defects of wheying off, flat flavor, and gassy appearance of the curd, and rapid deterioration. It was found possible to restore a vigorously agitated and wheyed sample of buttermilk to its original whey-free state by removal of air under vacuum. Viscolizing the reconstructed milk prior to cooling and culturing was of no apparent benefit. Pumping the finished buttermilk was objectionable in that air incorporation occurred regardless of the temperature of pumping, type and speed of pump, and condition of the curd.

The use of different cultures was responsible for differences in flavor, viscosity and acidity of the finished buttermilk; however, all cultures studied produced a satisfactory product. A.D.B.

The Bacteriological Grading of Milk. A Critical Study. G. S. Wilson, Assisted by R. S. Twigg, R. C. Wright, C. B. Hendry, M. P. Colwell, and I. Maier. Med. Rsh. Council Special Report Series No. 206, 393 pp., H. M. Stationery Office, London, 1935. Available in America through the British Library of Information, 270 Madison Ave., New York City, Price $2.15.

This report of the investigations by Dr. Wilson and his associates fully justifies the interest with which it has been awaited. The work was financed for the first two years by the British Empire Marketing Board, and after the dissolution of that Board by a grant from the Ministry of Health of Great Britain. The preface states that while Dr. Wilson has had the advantage of consultation with a special committee including representatives of different Government Departments, he is however, solely responsible for the conclusions reached.

This critical study is presented in two parts. Part I covering nearly 300 pages includes a discussion of the technic of tests used in the bacteriological grading of milk under four headings. Section A.—The Plate Count; B.—The Coliform Count; C.—The Methylene Blue Reduction Test; D.—Miscellaneous tests. The latter portion includes a discussion of the sediment test, the leucocyte content, the Breed smear method, acidity and pH tests, brom-thymol-blue test, keeping quality tests, laboratory pasteurization tests, the Frost little plate method and the Burri smear culture method.

Part II is a discussion of the interpretations that should be placed on the results secured from these tests.

All workers in this field will find themselves under obligation to Dr. Wilson and his colleagues for their study of the various causes of errors in counts secured by the standard agar plate technic. They make certain practical suggestions for improving this technic. American workers will not be surprised at the conclusion that the counts obtained by the present standard

agar plate technic are in general inaccurate and unreliable, but will be surprised at the conclusion that this technic should generally be replaced in milk grading work by other tests of milk quality.

Dr. Wilson and his associates have carried out valuable studies of the mechanism of the methylene blue reduction technic and reach the very interesting conclusion that a modified form of this test "seems to fulfill most of the requirements demanded of a test for the routine grading of raw milk." "The modification consists essentially in half-hourly inversion of the tubes so as to keep the fat and microorganisms in more or less homogeneous dispersion. Its effect is to shorten the time to decolorization, and by diminishing the experimental error of the test to render it suitable for the examination of high-grade milks." The author indicates that he is less certain regarding the value of this test as applied to the grading of pasteurized milk, but he believes it to be generally useful for this purpose. Some direct comparisons are made between the accuracy and variability of results secured from the modified methylene blue technic and the agar plate count that may easily be thought to imply more than is justified by the data presented.

Dr. Wilson's conclusions regarding other laboratory procedures are also of interest. He states "With the possible exception of certified milk, there seems to be no justification for the use of either the coliform test or the *coli-aerogenes* ratio test in the grading of raw milk" but that "on the other hand, the coliform test—may serve as an index of the efficiency of pasteurization" and less satisfactorily elsewhere. "The direct microscopic count has not received the attention it deserves" and "It is in the rapid grading of milk that it finds its greatest value." His conclusions regarding other miscellaneous tests are that while they may be and frequently are useful for special purposes, they are not particularly suitable for the routine grading of milk.

This book contains a report of so much valuable research that it should take its place in routine control laboratories beside the report on Standard Methods of Milk Analysis of the American Public Health Association. The statement on p. 371, that "In the United States of America, the plate count test has many strong opponents, and the general tendency is to place less and less faith in the value of this method of grading milk supplies" shows that our English colleagues find it as difficult correctly to evaluate ideas existent on this side of the Atlantic as we do to evaluate their ideas. R.S.B.

Investigation of Resazurin as an Indicator of the Sanitary Conditions of Milk. Guy A. Ramsdell, Wm. T. Johnson, Jr., and F. R. Evan, Rsh. Lab., Bureau of Dairy Industry, U. S. Dept. of Agr., Washington, D. C. Journal Dairy Science *18*, 11, p. 705, Nov., 1935.

As a result of two years of study the authors believe that resazurin gives more information about the sanitary quality of milk than any other chemical

indicator. The dye is reduced and changes color in milk in a manner similar to methylene blue.

For the determination of the sanitary condition of milk the resazurin test as described in the text requires only one hour, while the methylene blue test requires over five hours. Milk can be classified into four groups as regards sanitary condition by means of the resazurin test. Milks from diseased udders and milks from physiologically abnormal cows have significant effects on the reduction of resazurin, and hence the test aids in their detection. By observing the rate of color change of resazurin-milk mixtures over a period of hours of incubation, considerable information as to the flora can be obtained. A.C.D.

The Relation of Mastitis to Rennet Coagulability and Curd Strength of Milk. H. H. Sommer and Helen Matsen, Dept. of Dairy Industry, Univ. of Wisconsin, Madison, Wis. Journal Dairy Science *18*, 11, p. 741, 1935.

Curd strength and rennet coagulation studies were made on the milk samples from cows of the University of Wisconsin herd as segregated into normal and mastitis groups on the basis of diagnoses made independent of this study. The curd strength was determined by a modification of the Hill test. Rennet coagulation time was determined at 30° C. with commercial rennet extract added, 1 part to 2,500 parts of milk.

The average curd strength of the milk from 31 normal cows was 48.56 grams, and 39.17 grams for 15 mastitis cows. The average rennet coagultion time was 7.56 minutes for 30 normal cows, and 10.61 minutes for 15 mastitis cows.

The milk from the infected cows was also studied by individual quarters of the udder, comparing the milk from normal quarters with infected quarters. The average curd strength of the milk from the normal quarters was 45.35 grams, while the value for the milk from infected quarters of the same cows was 23.65 grams. A similar comparison for rennet coagulation time showed 9.70 minutes for the normal and 43.79 minutes for the infected quarters. H.H.S.

The Influence of Streptococci Infection of the Udder on the Flavor, Chloride Content, and Bacteriological Quality of the Milk Produced. C. S. Bryan and G. M. Trout, Mich. Agr. Exp. Station, East Lansing, Michigan. Journal Dairy Science *18*, 12, p. 777, 1935.

Much attention is being given today to the factors affecting the quality of dairy products. It is recognized that the quality of the raw or basic material plays an important rôle in the general quality of the processed product. Observations were made where milk produced under sanitary conditions and promptly cooled was not of good quality as determined by

flavor, chloride content, leucocyte content, methylene blue reduction test, and bacteria count. Since this reduction in quality could not be attributed to ordinary factors, that cause reduction in milk quality and since streptococci of mastitis were always found present in such milk, this investigation was undertaken to determine the relation of streptococcic infection of the udder to the quality of milk produced. Cow composite and individual quarter samples of milk were collected from the infected and non-infected cows in two herds; in addition similar samples were collected from a herd having no streptococcic mastitis. The samples were kept iced until examined. Standard methods were used to determine flavor, chloride and leucocyte content, methylene blue reduction time and bacteria count. In all cases the milk from the streptococcus-free cows was of highest quality, followed by the milk produced by the non-infected quarters of streptococcus infected cows. Apparently the infection in one, two, or three quarters of a cow exerts some influence on the quality of milk produced by other quarter or quarters. According to the same tests the milk from streptococcus infected quarters was of lowest quality. These facts are most important when dairymen are interested in the production of high quality milk. C.S.B.

Comparison of Skimmed Milk Powder Media with Standard Nutrient Agar for Bacterial Counts on Milk. ROBERT W. CANTLEY, Cornell Univ., Ithaca, N. Y. The Milk Dealer *24*, 12, p. 40, Sept., 1935.

Data are presented showing the bacterial counts on various types of milk as determined by plating on skimmed milk powder media and standard nutrient agar. The following conclusions are drawn:

1. The skimmed milk powder media produced higher counts than standard nutrient agar on milk of poor quality.

2. The colonies on skimmed milk powder media are much larger than those on standard nutrient agar, and hence much easier to count.

3. It is possible to differentiate types of bacteria present in a sample of milk by their growth on skimmed milk powder media, which is not possible with standard nutrient agar.

4. Preparation of skimmed milk powder media involves no additional technique.

5. Skimmed milk powder is cheaper than the ingredients used in standard nutrient agar. C.J.B.

Weigh Can Samples for Bacterial Analysis. A. H. ROBERTSON, N. Y. State Food Lab., Albany, N. Y. Proc. of 28th Annual Convention of Intern. Assoc. Milk Dealers, Lab. Section, p. 74, 1935.

The results of a study to determine whether the single can or vat sampling method is better as a basis of payment on grade when premium classes are defined at 10,000 and 25,000 bacteria per cc. limits indicated that while

in a few instances a producer would fall into a lower premium class by the vat sampling method there are about an equal number of instances where he will fall in a higher premium class. In other words, the method employed to enumerate the bacterial content is not sufficiently delicate in which individual cases to detect positively the presence or absence of weigh vat contamination where the successive counts do not vary excessively. A count of 100,000 was regarded as excessive and less than 1 per cent exceeded this figure.

Figures are presented to show degree of variation which can be expected from various factors involved in making plate counts. The author concludes in view of the above that the more representative weigh vat sample is fairer to all concerned than the individual can sample. E.F.G.

The Use of Tests for Colon Bacteria in Determining the Efficiency of Pasteurization and for the Detection of Contamination in the Plant after Pasteurization. J. M. SHERMAN, Cornell Univ., Ithaca, N. Y. Proc. of the 28th Annual Convention of Intern. Assoc. Milk Dealers, Lab. Section, p. 51, 1935.

Attention is called to the demonstrated ability of certain strains to survive pasteurization and of the sometimes lowered heat resistance of strains grown on artificial media. The very low numbers of heat resistant types of colon organisms present in many milk supplies make their detection difficult after pasteurization.

Actual results obtained by the author under practical conditions indicate that in only 2 per cent of the cases have colon bacteria survived pasteurization in numbers equal to one per cc. of milk. The use of colon tests must be applied with due caution recognizing the limitations of the test.

One of the most valuable uses to which the colon test has been applied in the dairy industry is for the detection of milk contamination in the plant after pasteurization. Of pasteurized milks which gave negative tests for colon bacteria at the pasteurizer, 40 per cent of the samples of the first milk bottles gave positive tests and 15 per cent of the samples representing the last bottled milk were positive. Random samples of bottled milk from the same plants gave positive tests for colon organisms in 29 per cent of the cases.

The liquid media method of detection and measurement of colon bacteria in milk is recommended and the formate-ricinoleate broth of Stark and England found to be best with the brilliant green bile of Maner and Harris as modified by Dunham and Schoenlein next. Formulae for these media are given. E.F.G.

The Use of the Dipper-Strainer at the Receiving Platform. J. F. JANSEN, Sheffield Farms Co., Oneonta, N. Y. Proc. of the 28th Annual Convention of Intern. Assoc. Milk Dealers, Lab. Section, p, 20, 1935.

Experience with the strainer dipper is cited where trouble with quality has been located when certain other methods had failed. A special type of strainer dipper to be used in individual shipper cans is described.

Samples are taken weekly or monthly by inspectors. The method of using the dipper is described and a system and forms for reporting the results promptly to the farmer are outlined. Six photographic illustrations of the appearance of the strainer dipper after a test show the various sorts of foreign material which may be present.

These are interpreted in terms of farm conditions. The author states that "strainer positive milk denotes one or more of the following conditions; mastitis, milk from stripper or fresh cows, dirty cows and poor straining, mixing of night's and morning's milk, slow cooling, poor cooling, frozen milk, dirty utensils and equipment, old milk mixed in, newly soldered cans that have been used without thoroughly removing all traces of soldering acid."

The author predicts a widespread use of this utensil as knowledge of its efficiency increases. E.F.G.

Errors in Bacterial Sampling of Milk on the Receiving Platform. Anna Kennedy Easton, Abbott's Dairies, Inc., Philadelphia, Pa. Proc. of the 28th Annual Convention of Intern. Assoc. Milk Dealers, Lab. Section, p. 60, 1935.

Techniques for bacterial sampling of milk in cans, weigh pans, and at the outlet valve are described. The average of 50 separate deliveries of milk gave the following figures:

Can composite count	9,239	colonies per ml.
Weigh pan count	10,765	" " "
Outlet count	9,223	" " "

The author concludes that the weigh pan or outlet method of sampling will give reliable results, is quicker, and there is less chance of contamination by either operator or physical conditions. E.F.G.

The Commercial Manufacture of Yoghourt Milk. E. Brochu, College of Oka, Quebec, Canada. Milk Plant Monthly *24*, 5, p. 37, May, 1935.

Yoghourt, a coagulated, concentrated whole milk, has long been recognized in Europe for its therapeutic value, where its sales are increasing. Recently its manufacture has met with a considerable amount of success in Montreal, Quebec, and other Canadian cities.

"Yoghourt results from the combined action of three specific strains of bacteria, namely, *Streptococcus thermophilus, Bacterium bulgaricum* and *Plocamo-bacterium yoghourtii*, on partially evaporated whole milk. The symbiotic association of the *B. bulgaricum* and *B. yoghourtii* produces the required acidity (1.0 to 2.0 per cent) in approximately three hours. The

S. thermophilus creates the pleasant aroma and attractive flavor, and the symbiotic activity of the three brings about coagulation within three hours."

Manufacturing and operations entail:

1. "Sterilization of milk by raising temperature to boiling point.
2. Addition of skimmilk powder in the proportion of 5 per cent (*i.e.* ½ lb. per gallon) to obtain a greater concentration of solids in milk or evaporation in steam kettle to ⅔ of its volume.
3. Rapid cooling to 115° F.
4. Addition of starter (2 per cent) and thorough mixing.
5. Bottling and capping in ½ pint bottles.
6. Incubation in hot water (113–118° F.) for three hours; complete coagulation occurs.
7. The Yoghourt is then placed in the refrigerator and is ready for delivery some eight hours later."

The package retails for five cents. Yoghourt is usually eaten like a custard, and may be flavored in many ways. G.M.T.

The Use of an Electric Steam Generator for the Sterilization of Dairy Utensils on the Farm. H. G. LINDQUIST, Mass. State College, Amherst, Mass. Milk Plant Monthly *24*, 1, p. 30, Jan., 1936.

Pails, strainers, and five- and ten-gallon milk cans, previously rinsed with contaminating culture, were subject to sterilization over a small commercial electric steam generator for periods ranging from four to six minutes for the smaller utensils and from six to eight minutes for the ten-gallon cans. By this treatment utensils showing a bacteria count averaging approximately 2,000,000 per cc. of rinse were rendered practically sterile. About four minutes were required to generate steam. The amount of current required to operate the generator for an hour was 0.85 K.W.H. Exposing the utensils for 1, 2, or 3 minutes was insufficient for satisfactory sterilization. G.M.T.

Relation of Temperature and Media to Bacteria Counts. ALEC BRADFIELD, Univ. of Vermont. The Milk Dealer *25*, 6, p. 41, March, 1936.

The use of a modified medium composed of trytone, glucose, skimmilk, and agar was compared with the standard method for obtaining the bacteria count of milk. An incubation temperature of 32° C. was compared with 37° C.

The author drew the following conclusions: The modified medium and lower incubation temperature will give consistently higher counts on raw milk than will the present standard method. The temperature of incubation has a greater effect upon this increase in count than the composition of the medium. The medium used produces colonies that stand out clearly and are easier to count than those grown on a standard media. C.J.B.

Catalase of the Lactic Acid Bacteria. DAGMARA TALCE-NIEDRA. Le Lait *16*, p. 225, 1936.

Certain strains of the true lactic acid bacteria (of the group *Streptococcus lactis*) product catalase. If strains of facultative anaerobes are cultured the catalase activity is not high. Catalase activity cannot serve as a means of defining the quality of lactic ferments. A.H.J.

The Hygiene of the Dairy in Relation to Infant Mortality. ACHILLE HAUSER AND MARC FOUASSIER. Le Lait *15*, p. 141, 1935.

During the period of life when the main nutrition of the infant comes from milk, infant mortality has shown a notable decrease between the year 1902 and 1932. A.H.J.

A Method for Determining Bacillus Coli in Milk, Buttermilk, and Cheese. M. LERNER. Le Lait *15*, p. 833, 1935.

After testing various methods for determining *Bacillus coli* in milk, buttermilk, and cheese, the indol method is recommended. This method gives clear results, it is easy to carry out and enables one to judge the sanitary quality of the products tested even in those cases where acidity and reductase tests have given favorable results. A.H.J.

A Mathematical Interpretation of the Reductase Test. T. MATUSZEWSKI, J. NEYMAN, E. PIJANOWSKI, AND J. SUPINSKA. Le Lait *15*, p. 1057, 1935.

A formula was elaborated for giving the mathematical relation between the initial number of bacterial cells and the decolorizing time for methylene blue in milk when pure cultures of *Streptococcus lactis* were used. The formula was based on the following three hypotheses, that the bacteria were in a logarithmic phase of reproduction, that each cell was capable of activating the same quantity of hydrogen in unit time, and that the methylene blue, added to the milk played the role of hydrogen acceptor. The moment of the disappearance of the color of the methylene blue indicated the exhaustion of the acceptors. Thirteen cultures of the group *Streptococcus lactis* have been subjected to the experiments in sterile skimmilk. The results of these tests confirmed in a satisfactory manner the theoretical deductions. It was thus established that the colored preparation could be employed with success in estimating the living cells of young cultures, that the particular cultures showed individual variations as regards time of reproduction (from 1 hour 14 minutes to 2 hours 46 minutes) and as regards intensity of activating (from 0.71×10^{-12} to 3.02×10^{-12} mille equivalent per hour), and that between the volume of the cells and the intensity of reproduction, a negative correlation existed, while between the intensity of the hydrogen

activated and the intensity of reproduction as well as between the hydrogen activated and the volume of the cells, the correlation was distinctly positive. A.H.J.

Consequences of the Obligatory Pasteurization (of Milk). NORMAN C. WRIGHT. Le Lait *15*, p. 980, 1935.

Aside from the acknowledged effects of pasteuriztion on the hygienic and nutritive properties of milk, a question is raised concerning the effects of pasteurization on certain economic results. It has been noted that price paid to the farmer for milk has not decreased, that small vendors of milk were unable to continue in business, and that the price of milk has been kept at a level sufficiently low that consumption has increased. A.H.J.

The Hygiene of Milk. ENRIQUE M. CLAVEAUX. Le Lait *15*, p. 971, 1935.

A discussion is given of the hygienic conditions under which milk is produced for Montevideo. A.H.J.

Directions for Conducting the Bacteriological Control of Milk. K. J. DEMETER. Le Lait *16*, p. 138, 1936.

Various classes of milk are discussed. The various grading factors such as odor, taste, appearance, and bacteriological results are weighted. Methods of determining reductase and catalase activity, total count, and the presence of coli are described. A.H.J.

The Ammonia Content of Cow's Milk. Its Significance in Alimentary Hygiene. Application to Sweetened Condensed Milk. M. POLONOVSKI. Le Lait *16*, p. 232, 1936.

The average ammonia content of 13 cows' milk was found to be 0.79 milligram per liter. The ammonia content of the milk increased on holding it at ordinary temperature. On boiling a sample of fresh milk, the ammonia content increased from 0.6 milligram per liter to 3.5 milligrams per liter. On holding the same sample of fresh milk for 24 hours, the ammonia content increased to 1.5 milligrams per liter and on boiling the held milk the ammonia content increased further to 20 milligrams per liter. The increase in ammonia was found to arise from the casein in the milk and not from the proteins in the whey. It is suggested that the increase in ammonia in held milk is due to microbial degradation of the protein. Sweetened condensed milk after storage in the cold or after exposure to 20° C. for 4 days after removal from the cold temperatures showed no higher ammonia content than did fresh boiled milk of the same milk solids content. It is therefore concluded that sweetened condensed milk may be considered a perfectly preserved product. A.H.J.

A Study of the Lecithin Content of Milk and its Products. B. E. Horrall, Dairy Dept., Purdue Agr. Exp. Sta., Lafayette, Ind. Agr. Exp. Sta. Bul. 401, March, 1935.

The Mojonnier modification of the Roese-Gottlieb method was used to extract the organic phosphorus along with the fat from dairy products. The colorimetric method of Deniges modified by Truog and Meyer was found to be an accurate method for the determination of organic phosphorus in dairy products. The lecithin content was calculated from the phosphorus content by multiplying it by 25.94 which is the factor for the oleyl-stearyl type of lecithin.

The lecithin content of the milk from three dairy cows shows that the fat contains a fairly constant percentage of lecithin after the fourth day of the lactation period. The colostrum milk fat contained a higher percentage of lecithin than did the fat of the milk later.

Factory milk contained a higher percentage of lecithin in the fat than did that of the fat from milk coming from normal individual cows. The average increase was 0.24 per cent.

Udder infections (mastitis) caused an increase in the percentage of lecithin in the fat of the milk when compared to that coming from normal quarters of the cow. A theory is given to explain this increase.

The lecithin content of skimmilk was on the average 13.91 per cent of the fat. Raw sweet cream contained on the average 0.428 per cent lecithin in the fat while that of raw sour cream contained 0.422 per cent. Pasteurized sweet cream butter contained an average of 0.232 per cent lecithin in the fat while that of pasteurized neutralized sour cream contained 0.170 per cent. Buttermilk from pasteurized sweet cream contained on the average 19.66 per cent lecithin in the fat while that of pasteurized, neutralized raw cream averaged 17.88 per cent. Lecithin in the fat of separator slime averaged 12.38 per cent. The results of one trial show that the lecithin content decreased materially in butter from sour cream while that of sweet cream butter remained practically the same over a storage period of 24 days.

The determination of the lecithin content in hens' eggs shows that the fat contains on the average 26.24 per cent lecithin and is fairly constant.

A method for the determination of the amount of eggs in ice cream mix is given. B.E.H.

Soft Curd Milk Studies. M. H. Berry, Maryland Agr. Exp. Station, College Park, Maryland. Md. Agr. Exp. Sta. Bul. 388, Oct., 1935.

The purpose of this investigation was to obtain more information regarding certain phases of the production, handling, processing and feeding value of soft curd milk.

It was found that there was not a great variation in the curd tension of the milk between milkings of the same or consecutive days over a short

period of time. Also, that the curd tension was usually fairly uniform throughout the lactation period except for a few days immediately after freshening. Colostrum formed a very hard curd upon coagulation. The average curd tension of the milk produced in one lactation period may vary widely from that produced in another. There was no variation in the curd tension of the milk under conditions prevailing at the Maryland Station. An abortion during the lactation period did not appear to have any effect upon the curd tension of the milk.

Holding milk for several days at 40° F. did not affect the curd tension when the acidity did not increase to any appreciable extent. Freezing milk had a hardening effect upon the curd. Viscolizing pressures of 3,000 to 5,000 pounds were required to change hard curd milk to soft curd milk. The greater the orignal curd tension, the greater was the percentage reduction following viscolization. Ordinary pasteurization temperature had no effect on curd tension, nor did heating at 160° F. for 30 minutes change a hard curd milk to a soft curd milk. A temperature of 180° F., however, had a marked softening effect on the curd. Heating milk to the boiling point in an open container usually softened the curd to below 30 grams curd tension.

In tests with rats, natural soft curd milk did not produce greater gains nor was it consumed more readily than normal hard curd milk or such milk rendered a soft curd milk by heat or pressure. C.W.E.

Vitamin D in Milk. T. M. Olson and G. C. Wallis, South Dakota Agr. Exp. Sta., Brookings, So. Dak. So. Dak. Agr. Exp. Sta. Bul. 296, Dec., 1935.

The literature on this topic is critically reviewed and original data extending our knowledge in certain phases of the problem are presented. The importance of milk in the adequate nutrition of children and adults is stressed. Milk contains generous amounts of calcium and phosphorus, the bone forming minerals, which gives added significance to its content of vitamin D, the antirachitic factor concerned with their proper utilization. The biological methods used for measuring vitamin D are described and the common units used for expressing the potency are defined.

Factors influencing the amount of vitamin D in the milk at the time of its production are discussed. At the South Dakota Station four generations of cows have been produced which have never been exposed to sunshine at any time. No measurable effect on growth were noted but the milk from animals of this group failed to protect pigs from rickets as effectively as milk from a check group of cows receiving the same ration but continuously exposed to sunshine. Butterfat from a second generation no-sunlight cow contained 64.8 Steenbock units per pound while that of another similar animal on summer pasture had 227 units. Trials were also run with rats

to demonstrate the relative vitamin D potency of typical summer and winter butterfat. The greater potency of the summer butterfat was indicated by the appreciably larger bone ash percentages at both 5 per cent and 10 per cent levels of feeding. This harmonizes with other reports which show that typical winter milk contains about five, or less, Steenbock (13.5 U.S.P.X.) units per quart as compared with approximately fifteen Steenbock (40.5 U.S.P.V.) units per quart of typical summer milk. Differences in the amount of sunshine received by the cow and in the amount of vitamin D in the ration consumed undoubtedly have a part to play in influencing the relative potencies of winter and summer milk but the exact influence of each can not be stated at the present time. Investigators have found that irradiating the cow with ultra violet light has enhanced the vitamin D content of the milk subsequently produced in some cases and in other trials it has failed to do so. However, the feeding of vitamin D concentrates to cows in sufficiently large amounts has resulted, uniformly, in increasing the content of this factor in the milk. Irradiated yeast is the most favored material for this purpose at the present time.

Although breast fed babies are less subject to rickets than bottle fed babies, investigators have been unable to demonstrate appreciable amounts of vitamin D in breast milk, it being inferior to cow's milk in this respect. The reason for its superior antirachitic properties in not known.

The continued widespread occurrence of rickets among infants indicates the necessity of a food source which will supply sufficient vitamin D along with the regular diet, and milk seems to be the logical vehicle for this purpose. Three types of milk with the vitamin D content increased above the normally occurring amount have been produced and are finding their way to our markets in increasing amounts. One type, irradiated vitamin D milk, is produced by directly irradiating the fluid milk so that it contains 50 Steenbock (135 U.S.P.X.) units per quart. Another is fortified vitamin D milk, produced by adding a cod liver oil concentrate to the milk in such amounts as to give a potency of 150 Steenbock (405 U.S.P.X.) units per quart. The third is called metabolized vitamin D milk, and is produced by feeding irradiated yeast to the cows in such amounts as to produce 160 Steenbock (432 U.S.P.X.) units of vitamin D per quart.

All three types of vitamin D milk are produced under the license of the proper authority and control measures are practiced to insure a dependable product of proper potency.

The value of all three types of vitamin D milk in preventing and curing rickets has been demonstrated. There seems to be a reasonable amount of evidence to indicate that, unit for unit, the vitamin D of irradiated milk and of metabolized milk are about equally valuable for the control of rickets in infants. Limited information about fortified vitamin D milk indicates results of a somewhat comparable nature. There are numerous instances

of the prevention and cure of rickets on milk intakes sufficient to furnish 40 to 50 Steenbock (108–135 U.S.P.X.) units per day, which may indicate the approximate lower limits of effectiveness on the average, with strong probability that somewhat larger amounts will be necessary for the complete protection of the young, more rapidly growing infant.

Fortunately, vitamin D is a relatively stable product, and there is little likelihood of appreciable destruction during the short holding period before fluid milk is consumed, or by the common methods of processing this product for consumption. C.C.T.

Quantitative Determination of Lactic Acid in Dairy Products. H. C. Troy and Paul F. Sharp, Cornel Univ., Ithaca, N. Y. Cornell Univ. Agr. Exp. Sta. Memoir 179, June, 1935.

A procedure designed especially for the quantitative determination of lactic acid in cow's milk and in cream is described. It consists in the precipitation of interfering substance in one step by copper hydroxide at 45° C., direct oxidation of the filtrate with potassium permanganate after acidifying with a sulfuric-acid manganese-sulfate mixture, distillation of the acetaldehyde with a large amount of water into sulfite solution, and titration of the bound sulfite with iodine. The method was found to be accurate to 0.002 per cent of lactic acid in the original milk.

In addition to a study, when applied to milk, of the effect of variations of procedure suggested in the literature, an extensive study of the factors influencing the blank on fresh milk was carried out, leading to a suitable correcting equation. It was found that the recovery of added lactic acid was incomplete, owing to the retention of lactic acid by the precipitate. The retention was due principally to lactose in the precipitate. The retention was found to increase with the amount of lactose (or glucose) in the precipitate, and was found to agree in behavior with the distribution of a solute between two immiscible solvents. An equation to suitably correct for the amount of lactic acid retained by the precipitate under varying conditions is given, together with the evidence justifying its use.

The method is applicable to cow's milk, cream, whey, butter, buttermilk, dried milk, and evaporated milk. It is not applicable to products containing sucrose. Its application to butter will be made the subject of a separate publication.

Results obtained on applying the method to a large number of samples are given. E.S.G.

Combination of Catalysts to Reduce Digestion Time in the Determination of Nitrogen. II. Dairy Products. C. F. Poe and R. R. Shafer, Chemistry Dept., Univ. of Colorado, Boulder, Colorado. Journal Dairy Science *18*, 11, p. 733, 1935.

Since Kjeldahl first introduced his procedure for determining nitrogen the time for digestion has been greatly reduced. In the present study many catalysts used in cereal and other products were used in analyzing different dairy products by the Gunning modification of the Kjeldahl method. When 0.3 gram mercuric oxide, 0.1 gram selenium, and 0.5 gram copper sulphate were used in combination as catalysts the digestion time was reduced from 105 to 13 minutes as compared with the standard procedure. The addition of these catalysts did not affect the accuracy of the results. A.C.D.

The Standardization of the Borden Body Flow Meter for Determining the Apparent Viscosity of Cream. J. C. HENING, N. Y. Agr. Exp. Station, Geneva, N. Y. JOURNAL DAIRY SCIENCE *18*, 11, p. 751, 1935.

Due to a demand from production men of milk plants for a simple method of estimating cream body, a simple efflux instrument called the Borden Body Flow Meter was developed by Nair and Mook. Since this instrument is coming into general use in milk plants for determining the apparent viscosity of cream it seemed desirable to compare results obtained with it with results obtained by using a standard instrument such as the MacMichael viscometer.

The results of comparative tests of the two instruments with sucrose solutions ranging from 20 to 65 per cent sucrose and cream ranging in fat content from 30 to 62.5 per cent are reported in this paper. The viscosity determinations of the sucrose solutions were made at 20° C. and those of the cream were made at 15.6° C.

The viscosities in centipoises for sucrose solutions as determined by the MacMichael viscometer when plotted against the seconds as determined by the Borden Body Flow Meter give a straight line relationship passing through zero which shows that the Borden Body Flow Meter gives correct results throughout the entire range for a true solution.

When plotting the results for cream, in a similar manner, the creams containing 30, 35 and 40 per cent fat show practically a straight line relationship but for creams of higher fat content the relationship is shown by a curved line.

For creams of higher viscosity the Borden Body Flow Meter consistently gave results which were higher than those obtained with the MacMichael viscometer. However, results on very viscous creams may be transposed to approximate centipoises by the standardization data secured on cream, thereby making it possible for those using the Flow Meter to compare their results quite accurately with data reported in centipoises. J.C.H.

A Study of Variations in the Lactose Content of Milk. W. R. BROWN, W. E. PETERSEN, AND R. A. GORTNER, College of Agr., Univ. of Minn., St. Paul, Minn. JOURNAL DAIRY SCIENCE *19*, 1, p. 81, Jan., 1936.

The lactose content of milk collected hourly from the cow was subject to considerable variation yet samples collected at the morning and evening milkings were rather constant in their percentage of lactose. A.C.D.

The influence of food fat of varying degrees of unsaturation upon blood lipids and milk fat. L. A. MAYNARD, C. M. MCCAY, AND L. L. MADSEN, Lab. of Animal Nutrition, Cornell Univ., Ithaca, N. Y. JOURNAL DAIRY SCIENCE *19*, 1, p. 49, Jan., 1936.

This study showed a definite relationship between the character of food fat and milk fat. A.C.D.

Soft Curd Character Induced in Milk by Intense Sonic Vibration. LESLIE A. CHAMBERS, The Johnson Foundation for Med. Physics and Dept. of Pediatrics, Univ. of Pennsylvania. JOURNAL DAIRY SCIENCE *19*, 1, p. 29, Jan., 1936.

When milk above the melting point of the fat was subjected to intense sonic vibration the curd was softened and the fat was partially homogenized. A.C.D.

Economic and Ingenious Methods of Equipping the Laboratory. F. E. A. SMITH, The Diversey Corp., Chicago, Illinois. Proc. of the 28th Annual Convention of Intern. Assoc. Milk Dealers, Lab. Section, p. 3, 1935.

How to equip the laboratory for certain necessary tests at the lowest possible cost through improvising laboratory equipment is discussed.

The following equipment is described and is accompanied by detailed drawings in each case.

1. Water bath incubator with thermostat for the methylene blue and fermentation tests, 300 test size.

2. Incubator for standard plate count made from old, well insulated, household mechanical refrigerator, total cost of which should not exceed $50.00.

3. Culture control cabinet for making starter culture and for incubating samples of milk and cream to determine actual keeping quality. This is made from a well constructed 75-pound ice capacity household ice box with thermostat temperature control, provision for both heating and cooling the interior and fan air circulation. The total cost should not exceed $25.00.

4. Colony counter for standard plate counting. This is a Wolffhuegel counting glass 6½ inches square so mounted and lighted that no light rays are directed toward the eyes except those reflected from the colonies which are thus very clearly shown.

5. Autoclave—For small numbers of routine counts a household pressure cooker may be used. For larger numbers a single wall autoclave with a

stirring attachment to facilitate solution of agar, etc., without high temperatures.

6. A power driven test tube washer is constructed mainly from the motor and flexible shaft of a used barber's clipper. A method of using this equipment is described. E.F.G.

The Cholesterol of Milk. JAMES A. TOBEY, Director of Health Service, Borden Co., New York City. Milk Plant Monthly *24*, 7, p. 56, July, 1936.

Cholesterol found in milk serves a beneficial function in human nutrition. During irradiation of the milk, the cholesterol can be changed to form vitamin D. The author, therefore, speaks of cholesterol as the pro-vitamin D. The general occurrence of cholesterol and its chemical constitution is also discussed. G.M.T.

The Laboratory. GEORGE M. PULKRABEK, Pure Milk Association, Chicago, Ill. Milk Plant Monthly *24*, 10, p. 36, Oct., 1935.

The author believes the laboratory plays an important part in quality improvement programs and cites numerous tests which should form a part of the daily routine in milk quality work. The minimum items of equipment required for the laboratory are listed together with layout plans and suggestions for installing electricity, steam, and water facilities. The author lists also the names and addresses of manufacturers or dealers from whom necessary laboratory equipment may be purchased. G.M.T.

A Monohydroxypalmitic Acid in Butterfat. A. W. BOSWORTH AND G. E. HELZ, Dept. of Physical Chem., Ohio State Univ., Columbus, Ohio. J. Biol. Chem. *112*, p. 489, Jan., 1936.

The methyl esters of the fatty acids in butterfat were fractionated and the fraction of the B. P. range 165–200° C. at 15 mm. was prepared. An optically active monohydroxypalmitic acid was separated from the saponified esters. The lead soap of this acid is soluble in ether and the barium soap is soluble in benzene. K.G.W.

The Relationship of Composition to Quality in Milk. J. C. MARQUARDT, N. Y. Agr. Exp. Station, Geneva, N. Y. The Goat World, *20*, 11, p. 7, Nov., 1935.

This study was made on samples of goat's milk collected throughout the United States in the first National Goat's Milk Scoring Contest. It is probable that the results apply to other milk.

Within a liberal range variations in fat, total solids, acidity, and curd tension did not affect the milk flavor scores. High lactose and low salt percentages were associated with high scores for flavor of goat's milk.

J.C.M.

The Simplified Method for Preparing Lactoflavine and a Study of Its Growth Effect. STUART ITTER, ELSA R. ORENT, AND E. V. MCCOLLUM, School of Hygiene and Public Health, Johns Hopkins Univ., Baltimore, Maryland. J. Biol. Chem. *108*, 579, 1935.

A modified method for preparation of lactoflavine using whey powder and hot ethyl alcohol is described. A yield of 20 mg. from 10 pounds of dried whey powder was obtained, which, when fed to rats in daily doses of 100 micrograms, produced an average gain in weight of eight to ten grams per week. K.G.W.

Simple and Easy Methods for the Determination of Fatty Matter in Milk. SECONDO REPETTO. Le Lait *15*, p. 15, 1935.

Ten cc. of milk, 1 cc. of isobutyl alcohol, and 10.5 cc. of 6 per cent sodium hydroxide are placed in a Gerber butyrometer and agitated vigorously for 30 seconds. The butyrometer is then placed in a water bath at 60–62° C. for 8 minutes, after which it is removed and the contents again vigorously agitated. After the butyrometer has been placed in the water bath at 60–62° C. for another 3–5 minutes, it is removed and centrifuged for 4–5 minutes. The fat content is read after placing the butyrometer in a water bath at 60° C. The Mørsin butyrometer was also used in determining the fat content of milk. One cc. of isobutyl alcohol, 5.5 cc. of 5 per cent sodium hydroxide and 9.5 cc. of milk are placed in the butyrometer and agitated vigorously for 30 seconds. The butyrometer is placed in a water bath at 60–62° C. for 7–8 minutes. The butyrometer is then removed from the water bath and shaken, after which it is returned to the water bath. After standing 10–15 minutes, the fat content is read. This method does not require the use of a centrifuge and is considered satisfactory for practical use. The results obtained do not differ substantially from those obtained with accepted procedures.

A.H.J.

The Calcium Phosphates of Milk. J. BRIGANDO, CHAMP, AND CLOSSON. Le Lait *15*, p. 382, 1935.

The salts of calcium and in particular the phosphates of calcium are considered in relation to changes in the milk. Acid milks, soft curd milks and heated milks are characterized by modifications of the proportions of the soluble and insoluble phosphates of calcium. The changes in the milk can in a certain sense be diminished by the addition of Ca and PO_4 in the proper ratio. For acid milks the phosphate added should be rich in Ca while for soft curd or "slow" milks the added phosphate should be poor in Ca. Cheeses prepared from milk which has been treated with the proper calcium phosphate are superior to cheeses prepared from untreated milk and ripen satisfactorily without the development of bitter flavors. A.H.J.

A Simple Technique Allowing Complete Analysis of Milk with a Reduced Sample of the Liquid. R. VLADESCO, Professor of the laboratory of biological chemistry of the faculty of Veterinary Medicine of Bucharest. Le Lait *15*, p. 363, 1935.

The density of the milk is determined in small flasks provided for the purpose. In order to determine the dry matter, 2 to 5 cc. of the milk are taken up in ash-free filter paper and dried. The increase in weight of the filter paper after drying gives the dry matter. The fatty matter in the milk is determined by extracting the dry matter on the filter paper with ethyl ether, calculating the loss in weight on extraction as fatty matter. The ether extracted dry matter is next extended with tenth normal acetic acid. Lactose and soluble salts are thus extracted and the total protein remains on the filter paper and is weighed. Portions of the acetic acid extract are used for determining the lactose by the Bertrand method, chlorides by the Charpentier-Volhard method, soluble phosphates by adding magnesium acetate, ashing, dissolving the ash in 20 per cent sulphuric acid and determining the PO_4 in this solution, and solution Ca by precipitation with ammonium oxalate and titration of the oxalate with potassium permanganate. Casein is calculated from the phosphorus content of the residue on the filter paper. Phosphorus in the dry residue was determined by ashing with magnesium acetate, dissolving the ash in 20 per cent sulphuric acid and then determining the PO_4 ether by the method of Copane or by a colorimetric method involving the use of ammonium molybdate, sodium sulphite and hydroquinone.

A.H.J.

Photometric Methods in the Examination of Milk and Dairy Products. CARL URBACH, Assistant in the Institute of Physics at the University of Prague. Le Lait *15*, p. 129, 1935.

The lactose content of milk is determined by the use of the Pulfrich photometer. The milk to be used for the lactose determination is treated in the following manner: To 10 cc. of milk are added 40 to 60 cc. of water, 2 cc. of a solution of potassium ferrocyanide (150 grams per liter) 2 cc. of zinc acetate solution (300 grams per liter) and a drop of phenolphthalein solution. Alkali is then added to the phenolphthalein end point, the volume made to 100 cc. and the liquid filtered. Ten cc. of the filtrate are diluted to 100 cc. and two cc. of the diluted filtrate placed in a Folin tube. The procedure of Benedict (*cf.* C.A. 25, 4296) as applied to the colorimetric determination of lactose is then used to develop the color which is measured by means of the Pulfrich photometer. Tables are given showing photometer readings for various concentrations of pure lactose under standard conditions of using the photometer.

A.H.J.

The Storch Reaction. ORLA-JENSEN AND M. O. WINTHER. Le Lait *15*, p. 247, 1935.

The Storch oxidase reaction for pasteurized milk has sometimes been found to be negative for freshly pasteurized milk but positive for the same milk after holding for some time. The authors state that properly pasteurized milk should show a permanently negative oxidase reaction. The oxidase reaction of milk high in leucocytes is rendered negative with greater difficulty than that of ordinary milk. Milks to which leucocytes were added in the form of separator slime decreased in the ease with which the oxidase activity could be destroyed by heat as the quantity of added separator slime was increased. A.H.J.

Contribution to our Knowledge of the Chemical Composition of Separator Slime. JAROSLAV MASEK, Polytechnic Institute at Prague. Le Lait *15*, p. 242, 1935.

Thirty-seven samples of separator slime were collected from various parts of Czecho-Slovakia during the several seasons of the year. These were analyzed for moisture and various nitrogenous constituents. The origin of the sample played an important part in the appearance, moisture content, and odor. The content of the nitrogenous constituents varied considerably. In addition to being influenced by physiological conditions, the composition of the nitrogenous constituents was influenced by the season of the year, by pasteurization and by the chemical composition of the milk. The composition of the separator slime from different layers on the separator bowl showed variation. The layer on the bowl surface was higher in casein than the inner layers. Separator slime from pasteurized milk was higher in casein than that from raw milk. A.H.J.

The Stabilization of Milk by Electrical Deacidification. W. WINKLER. Le Lait *15*, p. 505, 1935.

The reduction of the acidity of milk by electrical means increased its stability to heat. The keeping quality of such milk was improved as judged by rate of development of acidity. Pasteurized electrically de-acidified milk kept for 5 days at 10° C. and for 40 hours at 19 and 27° C. Non-pasteurized de-acidified milk also showed better keeping quality than milk not subjected to the de-acidification process. This process had no unfavorable effect on the flavor or odor of the milk. A.H.J.

Volatile Acidity of the Butterfat Taken from Cows Receiving Rice Bran in their Ration. NESTORE MONTI. Le Lait *15*, p. 609, 1935.

The index of volatile acidity of the butterfat produced by cows receiving rice bran in the ration was about 20 compared with an index of about 29 for

cows receiving the usual ration of grass, hay and wheat bran. The change in the index of volatile acidity was not due to the character of the fat in the rice bran as an index of volatile acidity of about 20 was still obtained when the fat had been removed from the rice bran by extraction. A.H.J.

Lipoid Phosphorus and Phosphatides of Cow's Milk. J. E. LOBSTEIN AND M. FLATTER. Le Lait *15*, p. 946, 1935.

By the use of several analytical procedures, the phosphatides in cow's milk were found to be about 300 milligrams per liter. The procedures used were such as to eliminate the inclusion of protein and inorganic phosphates in the extracts, which probably accounts for the low results obtained in this work as compared with the higher results obtained by other investigators. For the purification of lipoid phosphorus, the method used was to precipitate the casein with acetic acid to remove the fat from the coagulum with ether, and to extract the phosphatides from the residual coagulum with alcohol. The alcoholic extract was then submitted to fractional precipitation with acetone and magnesium chloride. In this manner about 150 milligrams of phosphatides per liter of milk were obtained. This procedure yielded about 50 per cent of the phosphatides known to be in the milk and give a product containing about 20 per cent impurities. The phosphatides of milk form a colloidal complex with the proteins or are united with the proteins by loose chemical ties to give combinations insoluble in ether but capable of dissociation in alcohol and acetone. A.H.J.

The Influence of the Duration of the Interval Between Milking on the Secretion of Milk and Its Content of Fatty Matter. J. GROH. Le Lait *15*, p. 854, 1935.

In experiments conducted with the "hanaque-bernoise" breed of cows it was found that when they were milked three times daily, a change in the hour of milking affected only insignificant differences in the total quantity and in the total fat content of the day's milk. However, the intensity of milk and of fat formation and even the percentage of fat in the milk were dependent not only on the duration of the interval between the last milking but also on time interval which preceded the previous milking. A.H.J.

A Certain and Rapid Method of Evaluating Milks to be Subject to Pasteurization. E. VAILLANT. Le Lait *15*, p. 961, 1935.

Milks of acidities lower than 16° Dornic are rejected as coming from unhealthy cows, milks of acidities between 16 and 20° Dornic are considered normal as concerns acidity, and milks with acidities higher than 20 are considered as questionable, probably having undergone lactic fermentation. The susceptibility of the milks to coagulation on the addition of acid was also determined. Milk at 15° C. does not normally coagulate until the

acidity becomes 70 to 75° Dornic. Also milk at 40° C. does not coagulate until the acidity attains a value of 50° Dornic. If, on adding acid to the milk, it coagulates before these equivalences of acidity have been reached, it is of questionable quality for pasteurization. The reasons for premature coagulation may be high original acidity or the presence of coagulating enzymes elaborated by bacteria present in the milk. A.H.J.

The Exactitude of the Different Methods of Dairy Control. STEFAN TAUSSIG. Le Lait *15*, p. 1087, 1935.

In determining the productiveness of the dairy, a study was made of frequency with which milk yield and fat content should be determined. It was concluded that weekly, biweekly, triweekly and monthly tests gave equally satisfactory results. When the tests were made it appeared that samples should be collected over a 48 hour period. A.H.J.

A Test for the Freshness and the Coagulating Intensity of Milk. E. PIJANOWSKI. Le Lait *16*, p. 1, 1936.

The general basis of the test is that milk will form a curd due to the decomposition of the calcium-casein complex when the acidity reaches a certain point (on the average 27° Soxhlet-Henkel). If the quantity of acid required for curdling a sample of milk is less than that calculated, it may be assumed that the capacity to form this curd prematurely is due in part to coagulating enzymes that have been produced by micro-organisms in the milk, *e.g.*, *Bacillus subtilis* and others. The higher the quantity of acid required for curdling, the higher may the degree of freshness of the milk considered to be. A formula is given for calculating the degree of freshness of the milk. Correction values are given for converting titrations obtained at several temperatures to 15° C. to which temperature the degree of freshness is calculated. Tenth normal solution of sulphuric, hydrochloric, lactic, and formic acids were used in determining the degree of freshness. The first named was considered to be the most satisfactory. In determining the degree of freshness, the acid is allowed to flow very slowly into milk at the same temperature. The flask containing 30 cc. of milk is carefully and constantly agitated until curdling occurs. A.H.J.

The Surface Tension of Cow's Milk. G. BELLE. Le Lait *16*, p. 13, 1936.

The surface tension of 70 mixed milks of the Casablanc region varied between 55.3 and 48.8 dynes at 18° C. The average surface tension was about 50.4 dynes. The surface tension of milk was highest immediately after milking and decreased about 3 dynes after 2 to 3 hours. On further holding for 24 hours the surface tension continued to decrease slightly. At 20° C. milk had about the same surface tension as at 18° C. However on cooling the milk to 10° and to 0° C. a lowering of surface tension resulted.

A minimum surface tension was obtained at 0° C. which was about 3 dynes lower than that obtained at 18° C. A.H.J.

The Electrical Deacidification of Milk. J. PIEN AND J. BAISSE. Le Lait *16*, p. 20, 1936.

The electrical deacidification of milk by passing it between aluminum electrodes has the disadvantage of producing much foam and a precipitate of casein on the electrodes and on the floor of the deacidifying vessel. The amount of casein precipitated depends on the deacidification accorded the milk. On reducing the acidity from 24 to 18° Dornic, 3 grams of casein per liter of milk was precipitated. Fat and solids not fat were also removed from the milk as a result of electrical deacidification but the quantities removed were not as great as the quantities of casein removed. The lactic acid which disappears as a result of electrical acidification is not destroyed but is bound in the precipitated curd and neutralized by basic salts which are formed at the electrodes. Milk which has been neutralized electrically does not show any decrease in lactose ion (as it is still present bound in the protein and as neutral lactate). Milk which has never been allowed to sour can be rendered alkaline due to the basic salts which are liberated as a result of the electrical deacidification procedure. Mild treatment by the deacidification procedure does not have any effect on the flavor or odor of the milk, except as the flavor of acidity is concerned, while strong treatment gives rise to off fishy odors which cannot be removed by aeration. The off flavors and odors are increased by subsequent pasteurization. Electrical deacidification has no effect on the bacterial content of the milk. Electrically neutralized milks were not considered suitable for sale. A.H.J.

MISCELLANEOUS

The Manufacture and Applications of Pipe. W. C. MOSER, National Tube Company, St. Louis. Ice and Refrig. *88*, p. 137, Feb., 1935.

The author discusses the type of piping most suitable for various uses including refrigeration. For the latter he recommends seamless piping, because ammonia leaks may be extremely costly, and in some cases are difficult to detect. Seamless piping is less susceptible to corrosive conditions because it is made from open hearth or electric furnace steel. Seamless piping costs from 10 per cent to 13 per cent more than buttwelded or lap-welded piping. L.C.T.

Air Conditioning. C. C. WINN, Detroit Inst. of Tech., Detroit, Michigan and W. H. E. REID, Univ. of Mo., Columbia, Mo. Ice Cream Rev. *18*, 8, p. 39, March, 1935.

A discussion of air conditioning with special emphasis on the methods commonly used to wash and filter air. Dehumidification and humidification methods are also described. J.H.E.

The Control of Corrosion in Air Conditioning Equipment by Chemical Methods. C. M. STERNE, Chief Eng. Metropolitan Refining Co., Long Island City, N. Y. Ice and Refrig. *89*, p. 1, July 1935.

In central air-conditioning systems, corrosion exposures are of the following types:

(1) Spray (a) Alternate, (b) Continuous.
(2) Humid atmosphere (a) Alternate, (b) Continuous.
(3) Water line (a) Agitated, (b) Quiescent.
(4) Velocity.
(5) Impingement.
(6) Acid (due to air contamination).
(7) Galvanic action, (due to different metals in contact).
(8) Electrolytic action (in rare instances, due to current leakage).

The rate of corrosion by water is affected by its softness, chloride content, carbon dioxide content, temperature, oxygen content, sulphate content and pH. Drops in the pH value from 7.0 to 3.3 have been recorded for water used in washing impure air.

The author discusses the advantages and disadvantages of various protective coatings for air conditioning equipment. Results of experimental work indicate the value of a combination of sodium dichromate and sodium hydroxide as an inhibitor of corrosion. L.C.T.

Metallizing, or the Spraying of Molten Metal. E. F. BESPALOW, Managing Engineer, Choctaw Culvert and Machinery Co., Memphis, Tenn. Ice and Refrig. *89, p.* DB, *July,* VTCE.

The author presents a short history, and also discusses the wide application and possibilities of the process. The minimum thickness of coating which can be applied is .0015 inch for one coat of the harder metals, and .0025 inch for the softer metals. Various thicknesses desired can be built up by applying any number of coatings. L.C.T.

What Constitutes a Satisfactory Water Supply? CLARENCE W. KLASSEN, Div. San. Eng., Ill. Dept. Pub. Health, Milk Plant Monthly *24*, 8, p. 32, Aug., 1935.

The physical, chemical, and sanitary qualities must be considered in judging the quality of water for dairy purposes. The physical properties include, color, odor, and taste. Dairymen are seldom concerned with coloring matter in water but frequently experience difficulty with water having objectionable odors, particularly hydrogen sulphide. Tastes in water caused by

certain minerals, algae and industrial wastes may be of concern. Minerals in water may result in (1) corrosion, (2) deposits, (3) nucleus or bond for milk stone formation, (4) reduction of washing powder effectiveness, and (5) may furnish material for certain bacterial growth, especially the iron bacterium, crenothrix. Water softening processes usually remedy these difficulties.

Proper location and construction are the important factors in developing a safe source of water. Details relative to location and construction of water sources are given. G.M.T.

A Study of the Composition of Boiler Water. J. L. BRAY, Prof. of Metallurgy, Purdue University, West Lafayette, Indiana. Ice Cream Rev. *18*, 8, p. 42, March 1935.

The composition of hard water, and the chemistry of the lime-soda and zeolite methods of softening are reviewed. The cause for embrittlement of boiler plate is discussed. A tabulation of the composition of feed waters used in boilers that have failed through embrittlement is given as well as the composition of water, which seldom causes embrittlement. The author points out that a low sodium sulphate ratio to alkalinity as sodium carbonate promotes embrittlement while boiler waters having a relatively high ratio of sodium sulphate to alkalinity as sodium carbonate are not likely to cause embrittlement.

To prevent embrittlement of boiler plate it is recommended that the boiler water be analyzed at regular and frequent intervals and when the requisite ratio is exceeded, steps should be taken to adjust the ratio either by suitable additions or by blowing out the boiler and starting over.

J.H.E.

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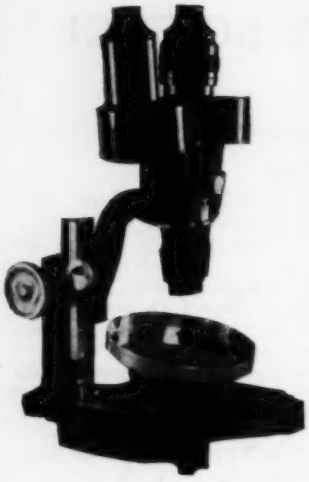

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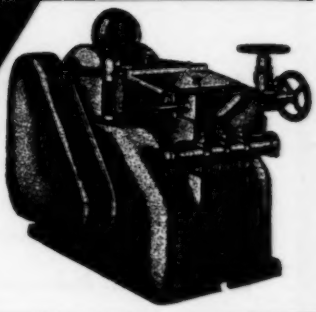

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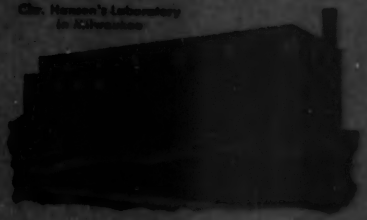

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